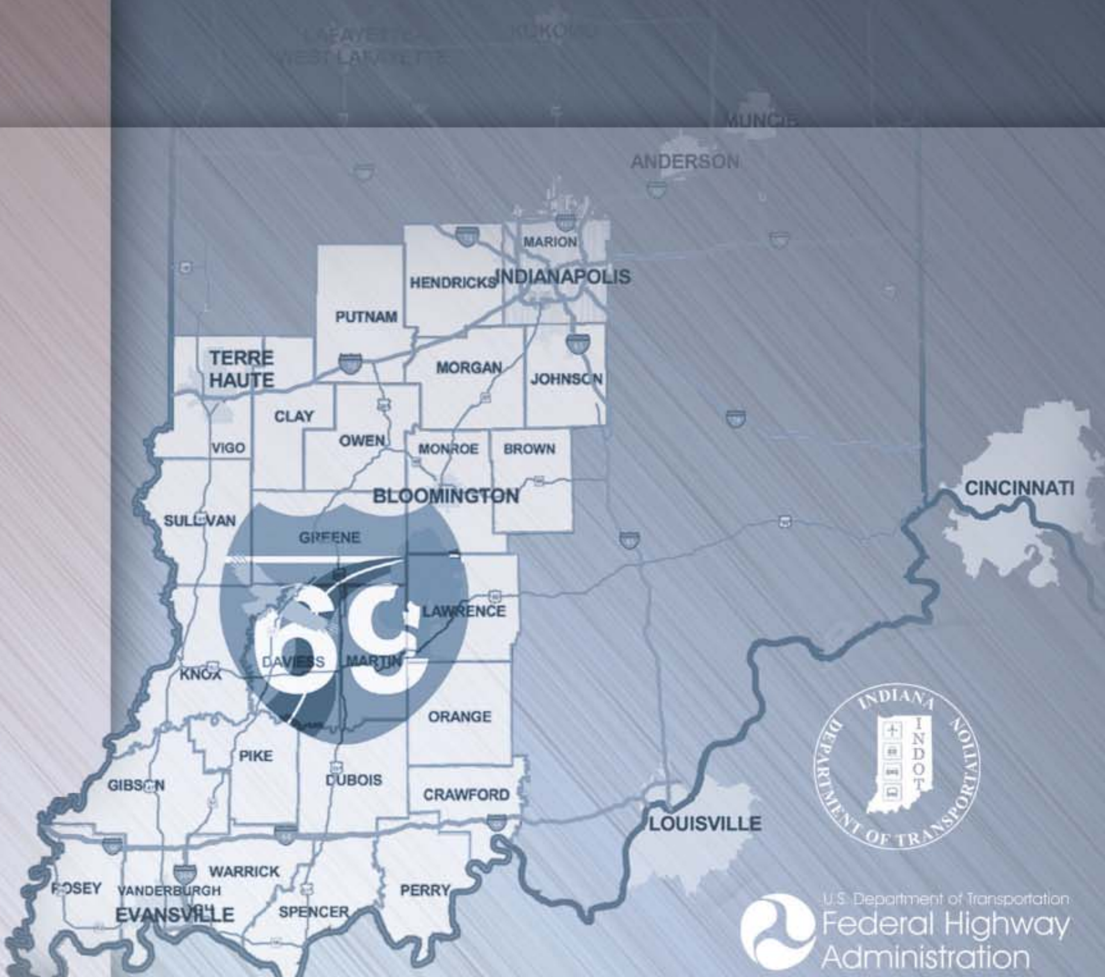
Analysis of Smart Mobility's

Review of I-69 Evansville to Indianapolis
Tier 1 Draft Environmental Impact Statement

November 2003



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Introduction

This report examines the document entitled *Review of I-69 Evansville to Indianapolis Tier 1 Draft Environmental Impact Statement* written by Smart Mobility, Inc. in November 2002. (For ease of reference, it will be referred to throughout this document as the "Report".) Smart Mobility was retained by various environmental advocacy groups and proponents of the US 41 / I-70 alternative (Alternative 1). This document has been prepared by Bernardin, Lochmueller & Associates, Inc. at the request of the Federal Highway Administration (FHWA) and the Indiana Department of Transportation (INDOT).

Our analysis will consider all issues raised by the Report, but not necessarily in the order in which they are found in that document. The issues addressed in this analysis are sequenced in order to facilitate the reader's comprehension if read from beginning to end; certain issues in the latter part of this document pre-suppose an understanding of topics addressed earlier.

A brief review of the chapters and the issues addressed in them are provided below:

I. **Issues Regarding Purpose and Need.** This chapter focuses on two issues raised in the Report. These are: (1) the appropriateness of using actual-to-straight line distance and travel time comparisons in the DEIS's Purpose and Need, and; (2) the appropriateness of using accessibility indices in the Purpose and Need.

II. **Number of Trips between Evansville and Indianapolis.** This chapter addresses the Report's contention that I-69 is not needed, because according to the Report there will be only 251 daily trips made between Evansville and Indianapolis. This assertion is based on a methodological error. Accurate data are provided in this chapter.

III. **Why Total VMT and VHT Were Not Used as Performance Measures.** An argument set forth in the Report is that aggregate vehicle-miles of travel (VMT) and vehicle-hours of travel (VHT) should be used as measures for evaluating the alternative corridors for I-69. This argument is evaluated and a conclusion given.

IV. **Cost Considerations.** A frequent assertion found throughout the Report is that the benefits of the various alternatives are really very similar, but that the costs are very different. From this, its authors reason that Alternative 1 should be selected, since it is the least costly. We agree that the alternatives' costs are different, but that these very real differences would be partially obscured if the Report presented the comparative cost data in the same way that they advocate the benefit data should be presented. The Report also claims that the benefits derived from added lanes on I-70 between Terre Haute and Indianapolis that INDOT is committed to undertake should have been included in the accounting of Alternative 1's benefits. Using their reasoning, this chapter reports the comparative cost of each alternative if the improvements to I-70 were treated as part of the I-69 project. A similar issue with respect to the treatment of planned improvements on SR 37 between Bloomington and Indianapolis is also addressed in this chapter.

V. **Are the Benefits Really So Small and Similar?** Throughout the document, the Report insists on the necessity of reporting project benefits in the context of the *total* value for that particular measurement. For example, it contends that the accident cost savings generated by each alternative should be discussed (and graphed) in the context of *total* accident costs throughout the region. The proposed approach has the effect of making the project benefit (in this case, accident cost savings) look very small and the comparison of the alternatives' benefits look very similar. This chapter analyzes the Report's proposed approach and provides evidence that the differences among the alternative's respective benefits are, in fact, real and significant.

VI. **Benefit Cost Analysis.** The Report endorses the idea that formal benefit cost analysis would have greatly informed decision-makers as to whether or not any alternative should be built. Further, it asserts that had such an analysis been conducted, if any of the alternatives proved to be worth building, it would have inevitably led to a preference for Alternative 1. This chapter explains why benefit costs analysis was not included as a performance measure in the DEIS analysis. It then reports on the results of formal user-benefit cost analysis conducted for Alternative 1 and the alternative that was selected by then Governor Frank O'Bannon and endorsed by INDOT – Alternative 3C. It reports the results and conclusion of this analysis.

VII. **Different Assumptions About Committed Projects.** The Report asserts that the omission of benefits derived from the committed addition of lanes to I-70 unfairly biased the results of the DEIS against Alternative 1. Similarly, the Report contends that certain planned projects along SR 37 should have been treated as "committed" and the fact that they were not unfairly biased the results against Alternative 1. This chapter repeats the benefit cost analysis (discussed in the preceding chapter) for Alternatives 1 and 3C as if the added lanes on I-70 were included as part of Alternative 1 and otherwise not built. In a separate analysis, it considers the effect of treating the SR 37 improvements as committed. The chapter presents the findings of the revised benefit cost comparison using the altered assumptions. It then draws conclusions regarding whether or not the assumptions used in the DEIS put Alternative 1 at a relative disadvantage, as alleged by the Report.

VIII. **Other Issues Raised in the Report.** The Report raises several other, less consequential issues. These issues are individually discussed in this chapter and conclusions are presented.

IX. Closing Thoughts: Conservative Nature of the DEIS Analysis. Several other assumptions embraced in the DEIS analysis were conservative and had the effect of producing a conservative estimate of the benefits that might be expected by I-69. These assumptions are reviewed and, where practicable, key performance measures are re-computed and reported for Alternative 1 and Preferred Alternative 3C based on less conservative assumptions.

Executive Summary

This document evaluates the report entitled *Review of I-69 Evansville to Indianapolis Tier 1 Draft Environmental Impact Statement* prepared by Smart Mobility, Inc. (November 2002) for certain citizen groups that are advocates for the I-69 Alternative 1 (US 41 / I-70). For ease of reference, Smart Mobility's report hereinafter is referred to as the "Report".

The Report challenged two aspects of the Purpose and Need of the *I-69 Evansville to Indianapolis Tier 1 Draft Environmental Impact Statement* (DEIS). First, the Report questioned the appropriateness of comparing actual-to-straight line distances and travel times as a method for demonstrating the need for I-69 in southwestern Indiana. Second, the Report contended that it was inappropriate for the DEIS to use accessibility indices as a measurement of need, because in their view I-69 would not be able to significantly change the accessibility of southwestern Indiana as measured by these indices.

Chapter 1 rebuts both of these claims. Regarding the actual-to-straight line comparisons, we point out that these data were not provided in the DEIS exclusively for the Evansville-to-Indianapolis connection. Rather, the DEIS provided the same comparisons for numerous cities to Indianapolis and demonstrated that Evansville's connection to Indianapolis generally is not as good as that of the other cities. We also point out that the DEIS provided statistical evidence that areas in southwestern Indiana were less accessible to Indianapolis than areas outside of southwestern Indiana an equivalent distance away from Indianapolis. Chapter 1 then documents that Alternative 1 would not significantly change this inequity, whereas Preferred Alternative 3C would totally eliminate the difference between 50-100 miles and dramatically reduce the difference more than 100 miles away from Indianapolis.

The Report also contends that there will only be 251 round trips per day between Evansville and Indianapolis in the year 2025. **Chapter 2** of this report demonstrates that the method used in the Report to come to this conclusion was flawed, because it neglected to count: (1) all trips traveling between Evansville and Indianapolis that have only one trip end in one of the two cities, and; (2) all trips passing through the corridor (i.e., trips with one end south of Evansville and the other end north of Indianapolis). Depending on whether or not induced travel demand is counted, the true 2025 forecast of trips traveling between Evansville and Indianapolis is between 9,929 and 11,210 one-way trips per day. About 30% of all vehicle-miles traveled on I-69 will be by vehicles making trips between Evansville and Indianapolis.

Chapter 3 challenges another critique made in the Report, namely: any good transportation project should reduce total vehicle-miles and vehicle-hours of traffic (VMT and VHT, respectively). Our analysis points out the fact that one of the goals of I-69 is to stimulate economic development in southwestern Indiana, which will inevitably bring with it additional traffic. There are two fundamental points made in Chapter 3. First, all the I-69 alternatives would increase weighted average speeds throughout southwestern Indiana. In other words, despite increases in vehicle-miles traveled, when total vehicle-miles are divided by total vehicle-hours, in every case, the resulting speeds are faster than the No Build scenario. Second, we provide evidence that I-69 will reduce travel times for those travelers who do not elect to make longer trips. Moreover, Preferred Alternative 3C is much more effective in creating this travel time reduction than Alternative 1.

A frequent assertion found throughout the Report is that the benefits of the various alternatives are really very similar, but that the costs are very different. From this, its authors reason that, if any alternative is built, it should be Alternative 1 (i.e., US 41 / I-70), since it is the least costly. We agree that the alternatives' costs are very different and have never purported otherwise. **Chapter 4** explores different ways of looking at the cost data and demonstrates that – contrary to the impression given in the Report– the DEIS's presentation of costs actually *tilts the results in favor of alternatives that make use of I-70* vs. those that make use of SR 37.

In summary, we have found almost no merit to the arguments put forth in the Report. In fact, if anything, our analysis has been conservative in the estimation of I-69's regional benefits.

Two themes are consistently repeated throughout the Report: (1) the benefits that would be derived from any of the I-69 alternatives are minimal, and; (2) the differences between them are so small as to be insignificant. The Report makes its first claim by presenting the benefits of the various alternatives (for example, increased jobs) as tiny tips atop bar charts of the total variable (for example, total employment) in southwestern Indiana or even the entire modeled area. In **Chapter 5**, we consider such performance measures as employment, business accessibility, traffic safety, and truck-hours saved and demonstrate that small percentage improvements to these variables still translate into large numbers. We also consider the issue of percentages in the context of environmental impacts and how the same methods used in the Report to make the project's benefits appear small could also be used to make impacts appear insignificant. As to the allegation that the benefits of all the alternatives are essentially the same, we show that the benefits of Alternative 3C are consistently significantly greater than those associated with Alternative 1.

One of the boldest assertions put forward in the Report is that a properly executed benefit cost analysis would likely lead to the conclusion that none of the I-69 alternatives is worthy of construction. The Report then goes on to qualify this position by saying that Alternative 1 might be the exception. **Chapter 6** responds to these assertions.

The benefit cost analysis conducted as part of this chapter applied two discount rates, one at 7% and the other at 4%. In both cases, Alternative 1 failed to demonstrate a benefit/cost ratio in excess of 1.0. By contrast, Preferred Alternative 3C had a benefit/cost ratio of 1.1 associated with the 7% discount rate and a net present value (i.e., discounted benefits minus discounted costs) of about $145.6 million. At the 4% discount rate, Preferred Alternative 3C's benefit/cost ratio moved up to 1.8 with a net present value in excess of $1 billion.

Despite allegations made in the Report that Alternative 1 was unfairly treated in the DEIS, **Chapter 7** reveals a very different picture. Using the analytical method that the Report recommends (i.e., benefit cost analysis), Alternatives 1 and 3C were re-evaluated under two modified sets of assumptions with respect to what are considered "committed" projects. Embracing the two sets of assumptions that the Report insists should have been used in the DEIS, we have conducted in this chapter two revised sets of benefit cost analyses. These are contrasted with the benefit cost analysis documented in the previous chapter, which we refer to as Scenario A.

For ease of reference the DEIS's baseline assumptions and the two revised assumptions are shown below…

- **Scenario A** – Scenario A is based on the same assumptions used in the DEIS. It assumes that two added travel lanes (one in each direction) on I-70 between SR 641 in Terre Haute and I-465 in Indianapolis are committed. In this case, benefits and costs associated with the I-70 improvement do not accrue to any of the I-69 alternatives. Scenario A also assumes that planned improvements to SR 37 between Bloomington and Indianapolis are not committed.

- **Scenario B** – Scenario B assumes that the added travel lanes on I-70 should be treated as uncommitted, which is the opposite of the assumption made in the DEIS. Under this scenario, the benefits and costs of the I-70 widening are attributed to Alternative 1.

- **Scenario C** – Scenario C assumes that planned improvements to SR 37 between Bloomington and Indianapolis should be treated as committed, which is the opposite of the assumption made in the DEIS. Under this scenario, the benefits and costs associated with the SR 37 improvements are subtracted from the benefits and costs of Alternative 3C.

In summary, Scenario B improves the net present value of Alternative 1 over Scenario A. Moreover, under this scenario Alternative 1 becomes economically viable (i.e., its benefits outweigh its costs). However, the set of assumptions used in Scenario B improves the net present value of Preferred Alternative 3C even more than it does for Alternative 1. This is due to greater diversion from a congested 4-lane I-70 to Preferred Alternative 3C than would occur if I-70 has six lanes.

Scenario C reduces the net present value of Preferred Alternative 3C. However, the net present value of Alternative 1 is diminished almost exactly the same amount, largely because the cost of

Preferred Alternative 3C is reduced, whereas the cost of Alternative 1 remains unaffected by this scenario.

In the final analysis, **Chapter 7** demonstrates that the assumptions with respect to projects on I-70 that were embraced in the DEIS accrued to the benefit of Alternative 1 when compared to Preferred Alternative 3C. It also shows that the assumptions regarding SR 37 improvements were neutral with respect to Alternative 1 versus Preferred Alternative 3C.

Chapter 8 deals with five concerns raised in the Report that we assess to be of a very minor nature. The first of these concerns pertained to the misclassification of five highway links (out of several thousand in the computer model) that the Report correctly pointed out were misclassified in most of the DEIS model runs with respect to whether or not they are located in the I-69 Study Area. None of these five misclassified links were close to any of the I-69 links. Related traffic congestion statistics were re-computed after the correction and it was determined that the misclassifications made virtually no difference in the overall results. The second issue pertained to the Report's objection to the DEIS's use of "percentage of congested road lane-miles" as a congestion performance measure. Upon reflection, we still conclude that this is a legitimate performance measure. The third issue related to the DEIS's limited treatment of economic data by regions within the DEIS. This omission is corrected in the FEIS. The fourth issue concerns the DEIS counting as economic benefits any growth within the Study Area that might come about as a result of relocation from another part of the country. From the perspective of the State of Indiana, we assert that the inclusion of relocated growth is very reasonable. Finally, we rebut the Report's contention that I-69 will not stimulate *per-capita* income growth by presenting historical per-capita income data from rural Indiana counties that have access to an Interstate highway and comparing them to counties that do not have such access.

In **Chapter 9** we discuss the generally conservative nature of the DEIS analysis. In this chapter, we present evidence which demonstrates that the DEIS analysis was conservative with respect to several key assumptions and forecasts that serve as input to the modeling of economic performance measures. Factors that are discussed include: (1) recent evidence from FHWA that our truck forecasts may be low; (2) the use of free flow travel times instead of more realistic average daily travel times in computing travel time-related benefits; (3) the use of redistributed trip tables in the base year, which had the effect of reducing forecasted user benefits, and; (4) the assumption that added lanes to I-465 at I-69's northern terminus would *not* be in place when I-69 opens to traffic. Without including higher truck forecasts, the chapter cites sensitivity analysis conducted on the other three factors and shows how the combination of less conservative assumptions regarding these three factors would have increased the employment growth forecast for the preferred I-69 corridor (i.e., Preferred Alternative 3C) by as much as 62% and real disposable income growth by 64%.

In summary, we have found almost no merit to the arguments put forth in the Report. In fact, if anything, the analysis conducted as part of the Tier 1 EIS for the I-69 Evansville to Indianapolis project has been conservative in the estimation of I-69's regional benefits.

I. Issues Regarding Purpose and Need

This chapter focuses on two issues raised in the document entitled *The Review of I-69 Evansville to Indianapolis Tier 1 Draft Environmental Impacts Statement* (Smart Mobility, 2002). (For ease of reference hereafter, the Smart Mobility report will be referred to as the "Report".) These are: (1) the appropriateness of using actual-to-straight line distance and travel time comparisons in the DEIS's Purpose and Need, and (2) the appropriateness of using accessibility indices in the Purpose and Need.

Actual to Straight Line Distance and Travel Time Comparisons

The Report criticizes an analysis documented in the DEIS's Purpose and Need chapter of the difference between the actual and the straight-line travel times and distances between numerous cities and Indianapolis. The Report states: "The DEIS leaps from the undisputed fact that there is no straight-line expressway between Evansville and Indianapolis to the conclusion that there is a 'need' for such a road." (page 9)

In fact, the DEIS makes no such claim. The Report's assertion might have merit if the analysis included only the connection between Evansville and Indianapolis. The Report fails to point out anywhere in its discussion that the DEIS's treatment of the Evansville-to-Indianapolis connection was a comparative analysis in which the same Actual-to-Straight Line Comparison (of travel times and distances) was made for the connections from *all* the major cities in Indiana as well as major border cities to Indianapolis. In making this apples-to-apples comparison, it was found that Evansville's connection to Indianapolis was generally the poorest among all the cities.

It should also be noted that four different measures of spatial separation were used in this analysis: (1) the index (ratio) of straight-line distance to actual distance, (2) the difference between actual and straight-line distance, (3) the index (ratio) of straight-line travel time to actual highway travel time, and (4) the difference between the actual and straight-line travel time.[1]

Of these four measures, the Evansville-to-Indianapolis connection ranked in last (i.e., 12th) place three times. In the case of the travel time distance index, two cities scored poorer than Evansville: Bloomington and Kokomo. Interestingly, those two cities have very straight connections to Indianapolis, but are disadvantaged because of heavy congestion on those straight routes. This also helps to explain why the I-69 alternatives that serve Bloomington consistently provide better performance than those that do not.

In short, the DEIS does not assert the need for a straight-line road between Evansville and Indianapolis. The need for an improved connection is based not only on distance, but travel time.

[1] All time and distance measures were based on the shortest inter-city travel time path as computed by the Indiana Statewide Travel Demand Model.

Moreover, the need is based on a fair *comparison* of the connection of numerous peer cities to Indianapolis *vis-á*-vis the Evansville-to-Indianapolis connection.

Accessibility Index Analysis

The DEIS's Purpose and Need employs a group of thematic maps that are color-coded and that demonstrate through the thematic color schemes that large portions of southern Indiana are less accessible than other parts of Indiana. Various measures of accessibility are used. Each is a mathematical "accessibility index" to a desired attraction. The accessibility indexes include: accessibility to population, accessibility to employment, accessibility to urbanized areas, accessibility to major airports, and accessibility to universities. Using accessibility to population as an example, all things being equal the accessibility index would be larger for an area of the state that is closer (measured in travel time) to a large city than an area that is farther away. Mathematically speaking, an accessibility index is a direct function of the sizes of the attractive force (e.g., population, employment, enplanements, university student enrollments, etc.) and an inverse function of the travel time to that attractive force. An accessibility index for a given area is the average or mean index value for that area to all other areas.

In this study, scores were computed for each traffic analysis zone in the Indiana Statewide Travel Demand Model (ISTDM), which includes large parts of Indiana's neighboring states. The Report is partially correct when it points out that southwestern Indiana has lower accessibility scores "primarily because it has a low population density and because it is more distant from the more densely populated Indianapolis and greater Chicago regions." (page 12)

In and of itself, this remoteness translates into regional economic, educational, medical, and cultural disadvantages when compared to many other areas in Indiana; thus, it is viewed by INDOT and FHWA as a legitimate concern for statewide planning.

Notwithstanding the legitimacy of poor accessibility as a need, the Report makes the following assertion: "Construction of a new highway can be expected to have very little impact on these low accessibility ratings." (page 12) If "little impact" is translated to mean "a change from poor to great", the assertion is probably correct. However, the more pertinent question is whether or not I-69 can be expected to measurably improve the accessibility ratings in southwestern Indiana – specifically, can it be expected to bring the I-69 Study Area on par with the rest of the State in terms of access to Indianapolis.

Much of the balance of this document compares the performance of the US 41 / I-70 alternative, known as Alternative 1 with the Preferred Alternative 3C, which is the preferred route specified in the FEIS. For ease of reference, these two alternatives are shown in Figures 1.1 and 1.2.

Figure 1.1: Alternative 1

Figure 1.2: Preferred Alternative 3C

Accessibility to Indianapolis: Inside and Outside the Study Area with and without I-69. The Purpose and Need chapter of the DEIS documents the fact that, for areas more than 50 miles away from Indianapolis, the I-69 Study Area suffers from poorer levels of accessibility to Indianapolis than other regions of the State an equivalent distance away from the capital city. This is a fact that the Report completely ignored. In other words, <u>in the No Build condition, when comparing areas approximately the same distance away from Indianapolis in and outside the I-69 Study Area, the area inside the Study Area is statistically less accessible to Indianapolis</u>. Specifically, if one compares the mean (i.e., average) accessibility index to Indianapolis for traffic analysis zones (TAZs) inside the I-69 Study Area (i.e., southwestern Indiana) in a band 50-100 miles away from the city with the mean score for TAZs 50-100 miles away located outside of the I-69 Study Area, it has been proven that the TAZs inside the Study Area have poorer accessibility than those outside. The same phenomenon holds true for areas more than 100 miles away from Indianapolis.

This "apples-to-apples" comparison is discussed on pages 2-16 and 2-19 of the Purpose and Need in Chapter 2 of the DEIS. Despite this discussion, the Report failed to acknowledge these differences in accessibility. This is a serious omission for two reasons: First, by comparing areas an equal distance away from Indianapolis, the relative degree of remoteness is controlled for. Second, since in both cases we are measuring accessibility to the same place (Indianapolis) and the indexes are not weighted by the population of the TAZ of origin, population density is not an issue. In this case, the only variable that can account for relative differences between accessibility levels inside and outside the I-69 Study Area is the transportation system, itself.

In the DEIS, the comparison inside and outside the Study Area was made for the No-Build condition. Using a "Student-*t* difference of means test" (more commonly referred to as a "*t*-test"), a "statistically significant difference" was found to exist between these two areas. A *t*-test is a statistical method for determining whether or not the average value of two sets of data are essentially the same or different. Standard practice involves making a statement about the degree of confidence with which one can say that the respective averages are the same or different. For most analytical purposes, if the *t*-statistic is larger than a pre-established threshold associated with a 95% degree of confidence, the analyst can say there is a "statistically significant difference" with 95% confidence (which means that there is less than a 5% probability that he/she is wrong). In this case, areas inside the I-69 Study Area have **lower** accessibility indexes than areas outside the Study Area an equivalent distance away from Indianapolis. In fact, we can say this with greater than 99% confidence.

These differences can be virtually eliminated if Preferred Alternative 3C is constructed. The same cannot be said of Alternative 1. The following paragraphs provide a more detailed description of this analysis.

There is a significant difference in accessibility to Indianapolis inside versus outside the I-69 Study Area. Alternative 1 would not significantly change this inequity. Preferred Alternative 3C would virtually eliminate the difference between 50 –100 miles and dramatically reduce the difference more than 100 miles away from Indianapolis.

The Statistical Analysis. The mean accessibility index to Indianapolis was computed for traffic analysis zones (TAZs) 50-100 miles away from Indianapolis both inside and outside the I-69 Study Area.[2] A difference of means *t*-test was computed comparing these two groups of zones both before and after an I-69 scenario was modeled.[3] This analysis was conducted for Alternatives 1 and 3C.

Initially, the comparison inside and outside the Study Area was made for the No Build condition. A statistically significant difference was found at greater than a 95%confidence level. After Alternative 1 was modeled, the accessibility-to-Indianapolis index was re-computed for each zone and the difference of means test was computed. In this case, the average index value for

[2] The test was not computed for the area less than 50 miles away from Indianapolis, since Indianapolis itself is a part of the I-69 Study Area.

[3] These tests are all based on an unpaired, one-tailed analysis. All assertions of statistical confidence are based on an alpha of .05 (or 95% confidence level) unless otherwise stated.

TAZs 50-100 miles away from Indianapolis was still significantly lower inside the Study Area than the average index value for zones the same distance away located outside the Study Area.

By contrast, within the 50-100 mile range after Preferred Alternative 3C was modeled, the average accessibility-to-Indianapolis index in and outside the Study Area became virtually the same number: 108.07 inside the Study Area versus 108.16 outside the Study Area. In other words, in a ring 50-100 miles away from Indianapolis Preferred Alternative 3C was successful at bringing accessibility to Indianapolis in southwestern Indiana onto a par with accessibility to Indianapolis an equivalent distance away outside southwestern Indiana.

The same analysis was then conducted for a concentric ring more than 100 miles away from Indianapolis. Again, it was found that in the No Build condition, the mean accessibility-to-Indianapolis indexes were significantly different inside versus outside the Study Area (79.75 inside and 85.86 outside). In this ring, Alternative 1 was found to improve accessibility only slightly inside the Study Area (80.97 inside versus 85.86 outside). Once again, Alternative 1 was not successful at providing parity to southwestern Indiana residents.

On the other hand, Preferred Alternative 3C clearly improved accessibility within this ring. Preferred Alternative 3C changes the mean accessibility index from 79.75 without the highway to 84.29 with the highway. This is compared to 85.86 outside the Study Area. From a strict, statistical standpoint, it is ambiguous whether or not 84.29 and 85.86 are significantly different. However, it is clear that under Preferred Alternative 3C the difference between these values would be substantially reduced.[4]

Tables 1.1 and 1.2 provide the statistical details for the 50-100 mile comparisons and the >100 mile comparisons, respectively.

In summary, there is a significant difference in accessibility to Indianapolis inside versus outside the I-69 Study Area. Alternative 1 would not significantly change this inequity. Preferred Alternative 3C would virtually eliminate the difference between 50-100 miles and dramatically reduce the difference more than 100 miles away from Indianapolis.

[4] At the 95% confidence level, we still must say that there is a significant difference even though the numbers have moved much closer together. However, if we want to be certain with 99% confidence, we can no longer say that the mean values are different.

Table 1.1: Difference of Means Unpaired One-Tailed *t*-Test: Accessibility-to-Indianapolis Index Averages for Traffic Analysis Zones 50-100 Miles away from Downtown Indianapolis Comparing No Build, Alternative 1, and Preferred Alternative 3C Scenarios

	No Build		Alternative 1		Alternative 3C	
	Inside	Outside	Inside	Outside	Inside	Outside
Mean	**104.62**	**108.16**	**104.76**	**108.16**	**108.07**	**108.16**
Variance	115.21	95.11	113.23	95.11	100.32	94.97
Observations	71	207	71	207	71	207
t-Statistic	-2.45383		-2.36932		-0.06973	
Critical *t*-Statistic	1.65857		1.65845		1.65776	
Confidence Level	> 95%		> 95%		<95%	

Table 1.2: Difference of Means Unpaired One-Tailed *t*-Test: Accessibility-to-Indianapolis Index Averages for Traffic Analysis Zones More than 100 Miles away from Downtown Indianapolis Comparing No Build, Alternative 1, and Preferred Alternative 3C Scenarios

	No Build		Alternative 1		Alternative 3C	
	Inside	Outside	Inside	Outside	Inside	Outside
Mean	**79.75**	**85.86**	**80.97**	**85.86**	**84.29**	**85.86**
Variance	19.54	29.13	19.04	29.13	16.67	29.13
Observations	61	172	61	172	61	172
t-Statistic	-8.73386		-7.04482		-2.35682	
Critical *t*-Statistic	1.65684		1.65675		1.65589	
Confidence Level	> 95%		> 95%		> 95%; < 99%	

So, What Does This Mean?

The above discussion has shown that it is entirely appropriate to use straight line-to-actual distance and travel time comparisons to demonstrate the need for I-69 when the analysis is done in the context of comparing data among numerous cities.

Moreover, with respect to accessibility to Indianapolis, the analysis has demonstrated that I-69 using the preferred Alternative 3C would bring virtual parity to the Study Area *vis-á-vis* the rest of the State. The same cannot be said of Alternative 1.

As the above discussion suggests, the interpretation of changes in accessibility indexes can be very difficult. What appear to be small changes can, in fact, be very significant. In the case of accessibility indexes, a small change can represent literally hundreds of thousands of people brought within a three-hour drive of Indianapolis. It can mean tens of thousands of people brought within commuting distance of jobs in major cities and hundreds of thousands of additional people brought within the buyer and supplier markets of regional businesses. All of these data were reported in Table 3-5 and 3-11 with explanatory text in the DEIS. Similarly, they are reported in Tables 3-5 through 3-7 and Tables 3-13 through 3-24 of the FEIS.

The accessibility indexes were of value chiefly for the purpose of demonstrating the geographic inequities that exist in southwestern Indiana. However, when it came to the evaluation of alternatives, INDOT and FHWA have generally used more readily comprehensible accessibility performance measures along the lines of those mentioned above.

II. Number of Trips between Evansville and Indianapolis?

The Report contends that there is virtually no travel demand to justify an Interstate that would connect Indianapolis and Evansville. The following quotation is of interest…

> After reviewing the travel demand model files provided by INDOT's consultants, we have found that Indianapolis is simply not a major destination for Evansville residents, and vice-versa. Nor would they become major destinations if I-69 is extended. INDOT's consultants' figures project that in the No-Build scenario there will be only 251 daily round trips between Evansville and Indianapolis in 2025. (page 10)

The mystery of 251 trips is partially explained by a footnote that reads: "Numbers in this section were extracted from the travel demand model using a 20-mile radius around the city centers to define "Evansville" and "Indianapolis." (page 10) What the Report's methodology failed to recognize is the number of trips with *only one trip end in Evansville or Indianapolis.* Evansville produces and attracts many trips that pass through Indianapolis to and from places farther north (e.g., Kokomo, South Bend, Fort Wayne, Detroit, etc.). Similarly, Indianapolis produces and attracts many trips that pass through Evansville to and from places farther south on a daily basis.

Also neglected in the Report's analysis is that there are many trips that *pass through* the Evansville area on their way to points north of Indianapolis. In like manner, there are many trips coming from places north of Indianapolis destined to places south of Evansville.

Accepted professional practice for quantifying the *total* number of trips being made between two geographically large trip generators would be to apply what is known as "select" or "critical link" analysis to that transportation link (or screenline of links) connecting the two areas. This is a standard tool available in virtually all travel demand modeling software packages. A slightly improved method available in TransCAD 4.0 is critical link analysis that permits the selection of *two links* on the same highway through which all trips between the two large generators would logically pass. This two-link method accumulates the total number of trips that passes through *both* points.[1]

This two-link method was applied to the question of how many trips will be made between Evansville and Indianapolis. The analysis was conducted assuming INDOT's preferred Alternative 3C is constructed. The two critical links were: I-69 just north of SR 64 on the south end and I-69 just south of SR 144 on the north end. Two forecasted 2025 travel demand scenarios were analyzed: (1) the Non-Induced Scenario and (2) the Induced Scenario.[2] The Non-Induced Scenario represents the conservative assumption that I-69 would not create any new

[1] This two-link method is superior to traditional single link analysis in that it prevents trips from being counted that may get on the highway somewhere in between the two points of concern.

[2] To be consistent with the analysis found in the Report, forecasted 2025 travel demand was used.

travel demand on its own. The Induced Scenario includes all forecasted I-69-induced travel demand.[3]

The Non-Induced analysis produces 9,929 (one-way) trips-per-day in 2025. The Induced analysis produces 11,210 trips-per-day. These numbers contrast sharply with the Report's forecast of 502 (251 round trips x 2) trips-per-day.

With over 11,000 vehicle-trips per day traveling between Evansville and Indianapolis on I-69, the difference in travel time savings provided by Alternative 1 versus Preferred Alternative 3C is substantial. For example, a 14-minute difference in travel time between Alternative 1 and Preferred Alternative 3C translates into a difference of over 900,000 hours of vehicle travel time saved annually for Evansville-to-Indianapolis trips alone.

Figure 2.1 is a traffic flow band-width map that graphically depicts the Induced Scenario.

[3] For more information on induced demand in the I-69 analysis, see sections 3.4.1 and 5.8.3 in the DEIS.

Figure 2.1: 2025 Traffic Flow
Band Width: Induced Scenario

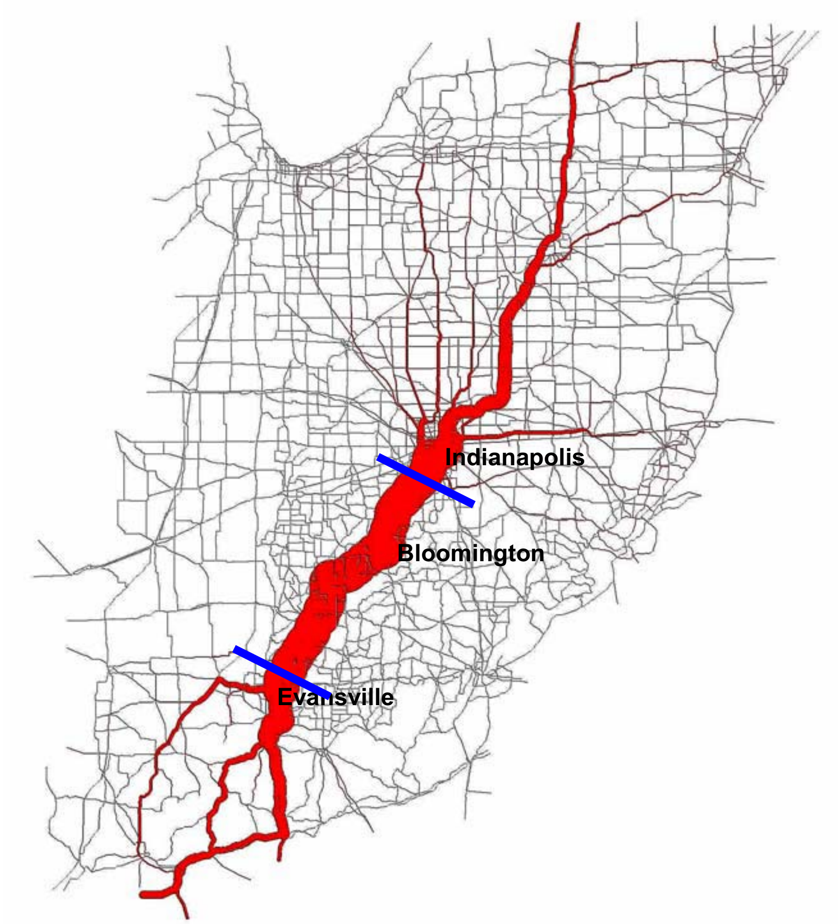
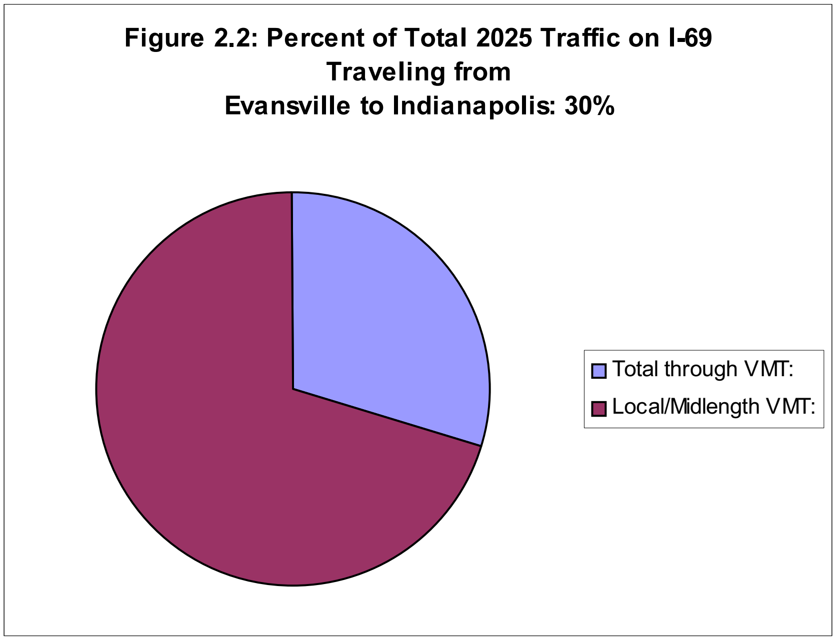


Figure 2.2 provides a pie chart of the corrected Induced Scenario forecast of 2025 vehicle-miles of travel (VMT) between Evansville and Indianapolis (in both directions) as a percent of total VMT that would use I-69 on any segment of the link between these two cities. This Evansville-to-Indianapolis share accounts for 30% of the highway's total usage.



Final Thought

The Report says…

> Since so few people are traveling between Evansville and Indianapolis, any time savings for these people from a straighter route is minimal. (page 17)

Using the logic expressed in this statement, since many people are traveling between Evansville and Indianapolis every day, perhaps a straighter route makes sense after all.

III. Why Total VMT and VHT Were Not Used as Performance Measures

Two excerpts from the Report …

> Under generally accepted transportation planning principles, performance should be measured by total time savings, i.e. travel time savings multiplied by the number of travelers, rather than by travel time savings alone.
>
> … (t)ime savings (VHT) are of real economic benefit and can be easily extracted from the transportation model. Similarly, VMT reductions will translate into operating cost savings. In general, lower VHT and VMT are better. Lower VHT means that people have more time out of their cars to do more things… Lower VMT means lower operating costs from less gasoline consumption, and more money to spend on other items. (page 15)

These statements are over simplifications. Lower VMT may be the result of shorter and fewer trips due to high congestion that results in higher vehicle operating costs. Lower VHT may simply mean that a project has been over-designed with excess capacity.

A Matter of Policy

A recurring theme throughout the Report is that net reductions in total VMT and VHT are universally desired transportation planning goals. It is asserted that these reductions should have been the overarching transportation performance measures by which the I-69 alternatives were evaluated. This line of thinking reflects an assumption that the less time spent in travel, the better. It neglects to recognize that facilitating mobility is a societal good in that it allows individuals *to choose* the option of traveling a longer distance within a relatively fixed travel time budget. For example, giving people access to more stores, medical facilities, and recreational opportunities within a fixed travel time budget is a real benefit.

There are many transportation projects for which lowering overall VMT and VHT are not appropriate goals. I-69 is one such project. In fact, one of its goals is to stimulate regional economic activity that will undoubtedly increase VMT, if not VHT.

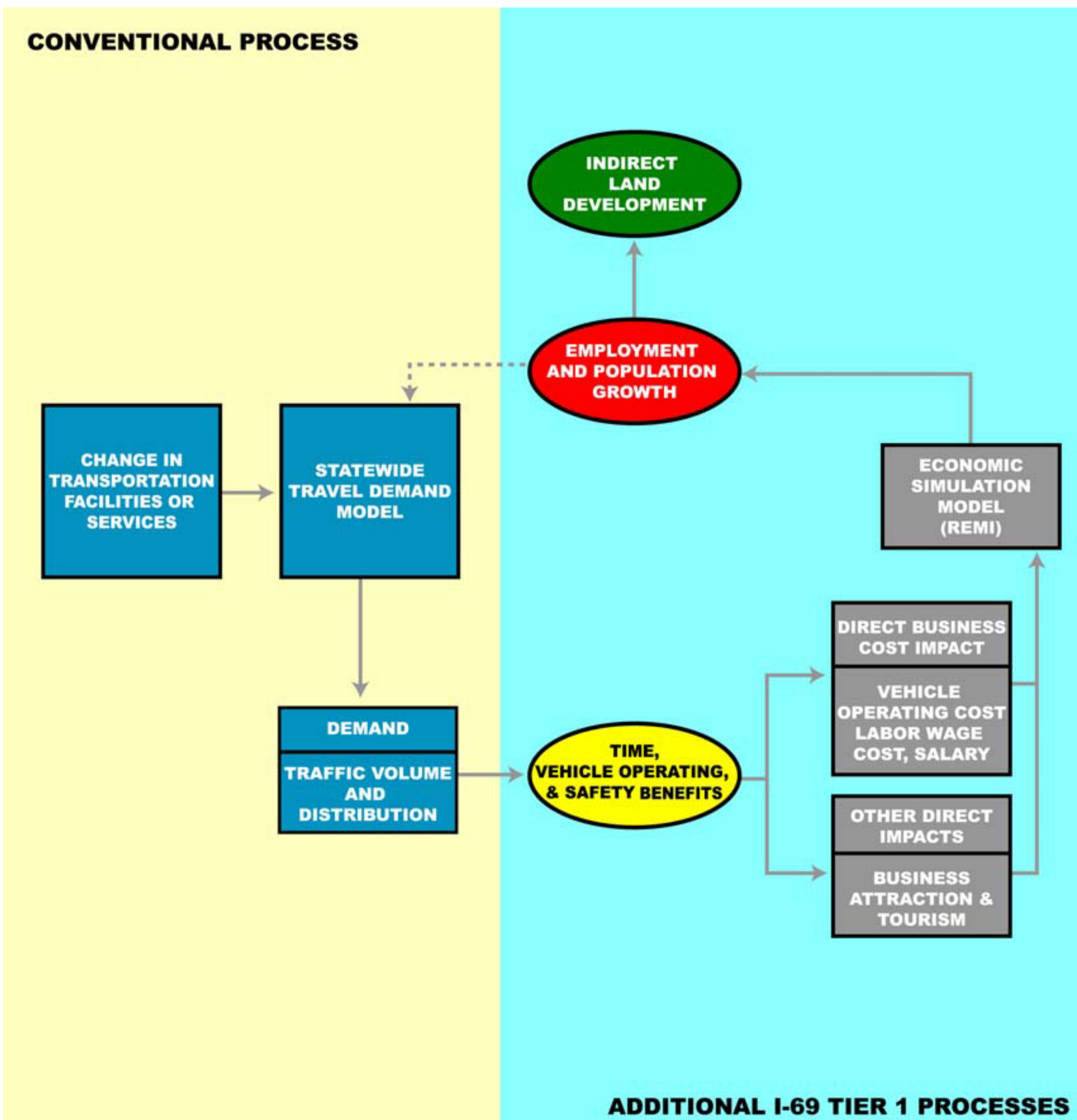
There are certain classes of projects for which net VMT and VHT reductions are appropriate performance measures. These tend to be urban projects that are specifically designed for the purpose of reducing mobile source emissions and increasing modal choices, such as public transit service improvement projects and localized traffic engineering projects. INDOT and FHWA are involved in sponsoring many such projects. However, while I-69 will not degrade air quality or restrict available mode choices, these are simply not its purpose and it would be unreasonable to evaluate it in terms of performance measures that are designed for other types of projects.

Induced Demand and Consumer Surplus

The failure to see a large decline in total VMT and VHT is due to several factors that were fully disclosed in Sections 3.4.1 and 5.8.1 through 5.8.3 in the DEIS. Collectively, the factors that tend to increase VMT may be referred to "induced demand". Virtually any large highway project will induce new or longer trips that have the effect of increasing VMT. This is the primary reason why it simply makes no sense to use net reduction in total VMT as a performance measure to evaluate alternative routes for I-69.

An integrated suite of transportation and econometric models/analytical tools was developed for this project. Collectively, this integrated system allowed for the computation of transportation and economic performance measures as well as estimates of indirect land use that would be stimulated by an I-69 alternative. Figure 3.1 depicts this integrated analytical process.

Figure 3.1: Integrated Analytical System Used in I-69 Study



The planning tools depicted above recognize and help to quantify the fact that total VMT will increase if I-69 is constructed.

A major component of induced demand is derived from the opportunity that any of the alternatives would allow longer distance travel within a roughly constant travel time. Transportation economists recognize this additional travel as a benefit – after all, people and businesses would not choose destinations farther away (choose to make longer trips) if they did not view it as a benefit. Economists refer to this as "consumer surplus" and are clear on how to measure its monetary benefits. There is ample literature on the subject – all of which was ignored in the Report.[1]

Economic Development and the National Development of I-69

In addition to the fact that some people will elect over the long haul to make longer trips, there are two other explicit components of induced travel that are addressed in the modeling process shown in Figure 3.1. These two additional components help to explain the across-the-board increases in VMT. They are: (1) the addition of new trips added to each model run generated by the increment of additional population and employment added to the Study Area as a result of economic growth stimulated by the highway, and; (2) additional long-distance trips that can be expected to enter Indiana as a result of the completion of I-69, nationally. All of these components of induced demand were fully documented in the DEIS and collectively represent a modeling approach that goes well beyond standard state-of-the-practice. The Report clearly acknowledges at least a part of these critical sections of the DEIS, since it quotes from Section 5.8.3 on page 18. Notwithstanding their knowledge of the fact that appropriate levels of induced demand were added to each alternative model run, the Report repeatedly leads the reader to believe that a good transportation project will always result in reductions in total VMT and VHT.

Effects of a Limited Access Highway on VMT

Another reason why VMT should not be used as a performance measure in evaluating I-69 has to do with the fact that it is – regardless of the alternative – a limited access highway. Consequently, motorists may have to drive a little farther than they would otherwise in order to use it. In modeling terms, the shortest travel time path for a trip that would use some portion of the highway often increases total vehicular miles. Because of the higher speeds that the highway offers, many will elect to drive a little farther to get to their final destination a little sooner.

VHT Reductions for the "Consistent Choice" Travelers

Were it not for induced demand and the effects of limited access, it would make sense to use VMT and (especially) VHT as performance measures. As it is, even with the addition of induced demand and the effects of limited access, total VHT (statewide or within the Study Area) only

[1] For a good discussion of the technical measurement of consumer surplus, see: "Estimating Highway Mobility Benefits", Patrick DeCorla-Souza, *Journal of the Institute of Transportation Engineers*, February, 2000. Also, see: Transportation Research Record 1685, *Issues Relating to Use of Travel Models in Benefit-Cost Analysis*, Patrick DeCorla-Souza, Federal Highway Administration.

varies from the No Build plus or minus less than 1% using the numbers shown in the Report, Table 1.[2]

Moreover, it is possible to *approximate* the effects that I-69 will have on reducing VHT for travelers who do *not* change their destination choices due to the highway. By modeling the "no-build travel demand" (in modeling terms, the trip tables produced by the No Build scenario without induced demand included), VHT generally goes down despite the longer paths associated with limited access. For example, Alternative 1 would reduce VHT by approximately 2,200 hours-per-day in 2025 under this scenario. By contrast, Preferred Alternative 3C would reduce VHT by around 19,800 hours-per-day under this scenario.[3]

Speed Improvements

In the final analysis, it is neither VMT nor VHT that are important. It is the relationship between the two. VMT divided by VHT equals weighted average speed. All things being equal, if speeds go up, congestion levels are probably going down. Table 3.1 does this simple calculation that was ignored in the Report.

Table 3.1: Study Area 2025 VMT, VHT and Average Speed Data[4]

	Study Area VMT*	Study Area VHT**	Speeds MPH
No Build	**48,972,183**	**1,434,278**	**34.14**
1	49,504,709	1,430,796	34.60
2A	50,013,522	1,446,987	34.56
2B	50,025,518	1,448,020	34.55
2C	50,501,128	1,436,242	35.16
3A	50,311,368	1,445,717	34.80
3B	50,494,422	1,430,460	35.30
3C	50,588,875	1,436,895	35.21
4A	49,843,859	1,438,919	34.64
4B	49,944,088	1,443,193	34.61
4C	50,362,406	1,432,932	35.15
5A	50,623,591	1,444,930	35.04
5B	50,711,553	1,436,154	35.31

* Report, Table 2, page 18.

** Report, Table 1, page 16.

2 Using the entire modeled area, which includes large portions of the surrounding states, total VHT is reduced from the No-Build for all but Alternatives 2A and 2B.

3 These two estimates may be slightly inflated, since the addition of induced demand will slightly increase congestion levels, thus slightly reducing speeds and associated travel time savings.

4 Since the publication of the DEIS, some of these data have changed slightly due to minor adjustments in corridor locations and the decision that Alternatives 2C, 3B, 3C, 4C, and 5B should stay on SR 37 in Marion County rather than using the Mann Road corridor. Notwithstanding these minor changes, the pattern is the same as what appears in Table 3.1. Moreover, for the present purpose, it was desirable to use the exact same data as was used in the Report.

Using the exact VMT and VHT data published in the Report, Table 3.1 demonstrates that – even with induced demand added into the traffic mix – average speeds improve over the No Build case for every alternative. It is also instructive to note that the alternatives which were identified as "preferred" in the DEIS generally achieve faster average speeds than those which were identified as "non-preferred". The notable exceptions are Alternatives 5A and 5B, which were identified as non-preferred for environmental reasons.

IV. Cost Considerations

A frequent assertion found throughout the Report is that the benefits of the various alternatives are really very similar, but that the costs are very different. From this, its authors reason that, if any alternative is built, it should be Alternative 1 (i.e., US 41 / I-70), since it is the least costly. We agree that the alternatives' costs are very different and have never purported otherwise. This chapter explores different ways of looking at the cost data and demonstrates that – contrary to the impression given in the Report – the DEIS's presentation of costs shows Alternative 1 in its most favorable light.

Costs Under Different Assumptions

There are many projects for which INDOT has a firm commitment. Most of these "committed projects" are scheduled maintenance or reconstruction projects or they are "expansion projects" already under design or even further along in the development process. Others are projects in the Statewide Long Range Transportation Plan for which INDOT has made a firm policy commitment to complete. An example of this latter type of project is the planned addition of a travel lane (in each direction) on I-70 from the Illinois to the Ohio state lines. It is INDOT's intention to build this added capacity along I-70 regardless of whether or not I-69 ever comes to fruition and without respect to which alternative is built. For this reason, the DEIS correctly attributed neither the costs nor the benefits of the I-70 upgrade to any of the alternatives that would make use of I-70.

> *The Report never mentions that if the I-70 lane additions should be treated as benefits attributable to the US 41 / I-70 alternative, so should their costs.*

The Report claims that the benefits derived from the added lanes INDOT is planning on I-70 between Terre Haute and Indianapolis should have been included in the accounting of Alternative 1's benefits. It contends that by not doing this, the DEIS unfairly biased its alternatives analysis against Alternative 1. However, it is never mentioned that if the benefits of these lanes should be attributed to Alternative 1, so should their costs. Using the Report's reasoning, this section presents the comparative cost of each alternative, if the improvements to I-70 were treated as part of the I-69 project.

While the Report argues that the I-70 improvements should not have been treated by INDOT as "committed", it argues just the reverse regarding the treatment of certain planned improvements on SR 37 between Bloomington and Indianapolis. INDOT did not treat these improvements as committed and therefore did not deduct any costs because of them. Rather, INDOT attributed both the full costs and the benefits to I-69 for those alternatives that make use of SR 37.

With respect to the planned SR 37 projects, INDOT decided to take a "wait and see" approach pending the outcome of the I-69 debate. It was reasoned that any of the I-69 alternatives could conceivably divert enough traffic off of SR 37 or add sufficient capacity to SR 37 that they would obviate the need to undertake the planned improvements. Whereas, long-term growth on I-70 is expected to justify added lanes regardless of the I-69 alternative that is built.

I-70 Alternatives. Several of the DEIS alternatives would make use of at least a portion of I-70 between Terre Haute and Indianapolis. The most obvious example of these is Alternative 1, which would use all of I-70 from the interchange of SR 641 (the committed Terre Haute Bypass) on the west to I-465 on the east. However, the complete list includes all of the following:

- Alternative 1
- Alternative 2A
- Alternative 2B
- Alternative 3A
- Alternative 4A
- Alternative 4B
- Alternative 5A

SR 37 Alternatives. The I-69 alternatives that make use of all or part of SR 37 between Bloomington and Indianapolis are:

- Alternative 2C
- Alternative 3B
- Preferred Alternative 3C
- Alternative 4C
- Alternative 5A
- Alternative 5B

Alternative 5A is unique insofar as it would use both a part of I-70 and a part of SR 37. For the purposes of the following discussion, **Alternative 5A is treated as both an I-70 alternative and a SR 37 alternative,** because the cost implications of the altered assumptions come close to offsetting one another.

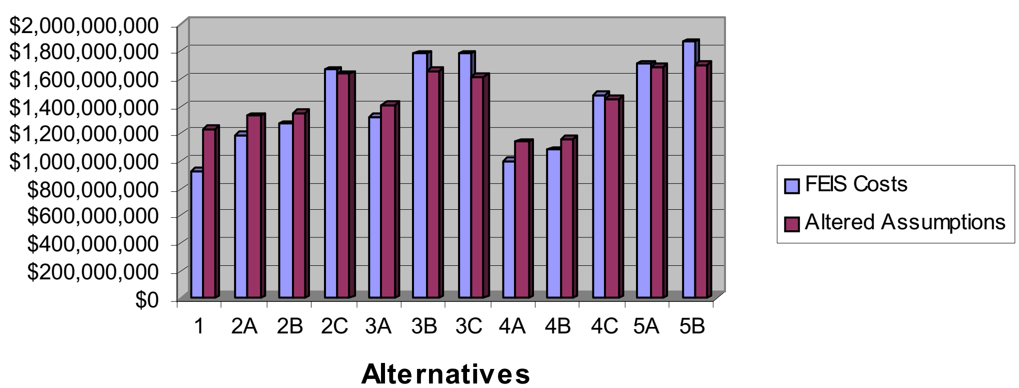
The alternatives have undergone cost refinements since the publication of the DEIS. All of the costs reported in this document are based on the costs that appear in the Final EIS (FEIS, Table 3-33: Construction, Engineering and Right-of-Way Costs). Table 4.1 provides cost data for all the alternatives in two ways: first, as they appear in the FEIS, and second, as they *would appear if the planned lane additions to I-70 had not been treated as committed and if the planned capacity improvements to SR 37 had been treated as committed.*

Table 4.1: Costs of Alternatives: Average FEIS Costs and Altered Average Cost Assumptions

	FEIS Costs	Altered Cost Assumptions
1	$925,000,000	$1,235,000,000
2A	$1,190,000,000	$1,330,000,000
2B	$1,270,000,000	$1,350,000,000
2C	$1,665,000,000	$1,635,000,000
3A	$1,325,000,000	$1,405,000,000
3B	$1,780,000,000	$1,660,000,000
3C	$1,780,000,000	$1,610,000,000
4A	$1,000,000,000	$1,140,000,000
4B	$1,080,000,000	$1,160,000,000
4C	$1,480,000,000	$1,450,000,000
5A	$1,710,000,000	$1,690,000,000
5B	$1,870,000,000	$1,700,000,000

Figure 4.1 provides the same data in graphical form. Important to note is the fact that the cost differences among the alternatives, while not equalized, are reduced if one embraces the altered assumptions.

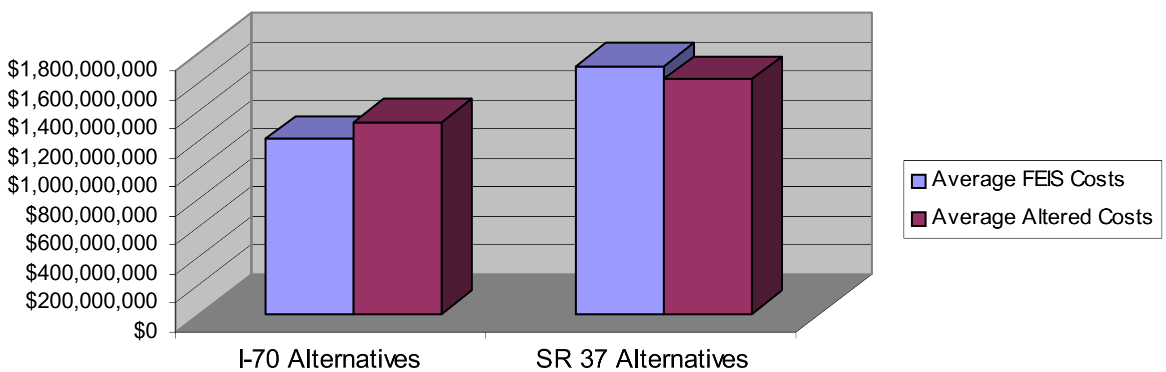
Figure 4.1: Costs of Alternatives Before and After Assumption Changes



In reviewing the altered assumptions data, it can be seen that the costs of all the I-70 alternatives increase, while the costs of all the SR 37 alternatives decrease. It should also be noted that Alternative 1 under the altered assumptions scenario is no longer the least expensive route. In this case, Alternatives 4A and 4B – the two alternatives with the largest number of new terrain miles – become less expensive than Alternative 1.

The pattern of cost shifts between I-70 and SR 37 alternatives can be more easily seen by simply contrasting the average costs of the I-70 and SR 37 alternatives before and after the altered assumptions are made. Figure 4.2 illustrates these contrasting averages.

Figure 4.2: Effect of Altered Assumptions on Average Costs



The I-70 average cost goes up almost $116,000,000, while the SR 37 average alternative comes down $90,000,000.

Conclusions

For the purposes of cost analysis, the DEIS did not bias the results against Alternative 1. In fact, as the above data prove, the DEIS gave the benefit of the doubt to Alternative 1 by not counting the costs of improving I-70 between Terre Haute and Indianapolis. If the per-mile, *pro-rata* costs of I-70 had been attributed consistently across the board to all the alternatives that make use of some portion of I-70, Alternative 1 would no longer be the least expensive route choice. Interestingly, that distinction would go to the two alternatives with the highest new terrain mileage in both real and percentage terms. Those two alternatives are 4A and 4B.

The effect of altered assumptions regarding I-70 and SR 37 as they pertain to project benefits will be addressed in Chapters 7 and 8.

V. Are the Benefits Really So Small and Similar?

Two themes are consistently repeated throughout the Report: (1) the benefits that would be derived from any of the I-69 alternatives are minimal, and; (2) the differences between them are so small as to be insignificant. "New terrain alternatives" are particularly singled out as having "very minor benefits and high costs" (see the Smart Mobility Report*,* page 5) without reference to the benefits or costs of those alternatives that are not "new terrain". At no place are these terms defined. Moreover, it is never acknowledged that the only alternative that is clearly not "new terrain" (Alternative 1) invariably shows fewer benefits that than those which might be classified as such. This chapter will discuss whether or not the benefits of I-69 are, in fact, "minimal" and will reiterate facts pointed out in the DEIS, which demonstrate that some alternatives clearly do better than others.

Transportation Planning: Analysis of the Margins

When evaluating alternative projects, it is customary to examine the relative improvement in the performance measures that have been selected to quantify goals achievement. While there may be performance measures that represent system-wide variables (such as a system-wide volume-to-capacity ratio), the focus is always on comparing the *change* effected by the various alternatives.

> *If the DEIS had reported environmental impacts in their "context" only, the reader would have been left knowing only that I-69 would account for at most 0.09% of the wetlands, 0.2% of the farmlands, and 0.1% of the forests that exist in southwestern Indiana.*

Despite the fact that this is exactly the way alternatives were analyzed in the DEIS, the Report contends that the DEIS's exercise of standard practice is misleading. The Report insists that the honest way of presenting the data would have been to do so in the context of the regional or statewide total for that variable; for example, increases in employment would be graphed as tiny tips atop bar charts of total employment in southwestern Indiana (leaving the impression that those tips are all insignificant and very similar).

There is some value in discussing aggregate regional conditions to provide a context for examining the impacts of the alternatives. In fact, the DEIS's Chapter 2: *Purpose and Need* as well as Section 5.26: *Cumulative Impacts* do just that. However, to stop there would be to obscure the real differences among the alternatives. For example, if the DEIS reported wetlands, farmland, and forest impacts in their "context" only without reporting the actual direct and indirect acres that would be affected by each alternative, the reader would have been left knowing only the following bits of information: I-69 alternatives account for at most 0.09% of the total wetlands, 0.2% of the total farmlands, and 0.1% of the total forest acreage in southwestern Indiana. One would be left with the impression that these impacts are truly insignificant and that the differences among the alternatives are really not worth worrying about. Figures 5.1 and 5.2 are examples of what the farmland and wetlands data would have looked like if the DEIS had presented these resource impacts in the way that the Report insists is proper. The difference between the No Build and any build alternative is so small as to be virtually invisible.

Figure 5.1: Acres of Southwest Indiana Farmland with and without I-69

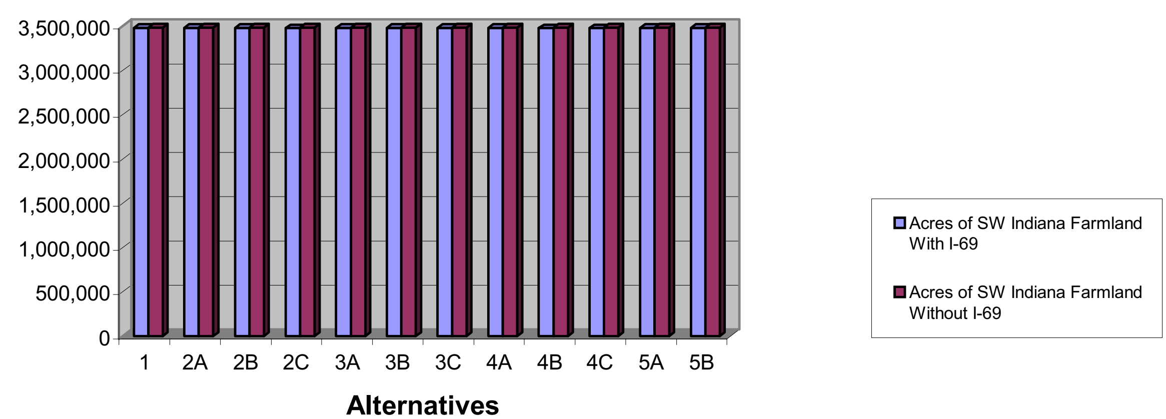
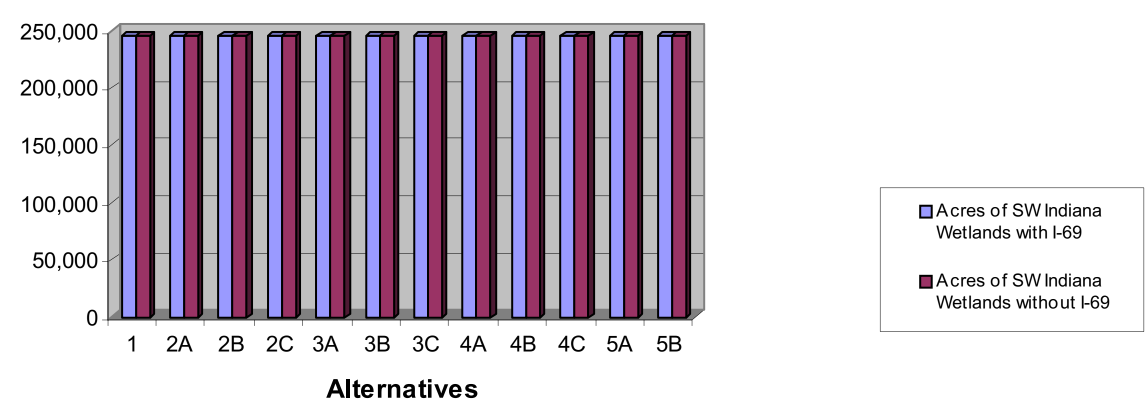


Figure 5.2: Acres of Southwest Indiana Wetlands with and without I-69



If the reader accepts the logic implicit in the Report, it would be difficult to justify many public investments. Publicly funded research for cures for many diseases would not be undertaken, because the cures would only slightly increase average life expectancy. Many welfare programs could not be justified, because they only improve the average incomes of the American family by a miniscule amount. Economic development programs could not be funded, since they only increase regional employment trends fractionally. The fallacy of these statements is readily transparent. Small changes to very large numbers can still be of great societal significance.

Small changes to very large numbers can still be of great societal significance.

Employment

Using employment as an example, consider which is the more straightforward way of reporting the effects of competing I-69 routes: Method "A" – simply reporting the number of new (permanent) jobs that each alternative is likely to create, or; Method "B" – hiding the increases in job creation within the "context" of the entire employment base of the I-69 Study Area (which, incidentally, includes Indianapolis) as advocated in the Report. Whether you judge the number to be impressive or not, at least using Method "A" you know what the number is: in this case, 4,300 permanent, new jobs for Alternatives 3B and 3C ranging down to a low of 1,400 for Alternative 1. For this performance measure, the former is more than three times better than the latter. Under Method "B" all the reader knows is that the alternatives seem to look alike, since the job creation number is dwarfed by the job base and that Alternatives 3B/3C are 0.27% versus 0.09% of the employment base, both ostensibly insignificant numbers.

Business Accessibility

In this case, the Report converts the data in the DEIS into a "dimensionless variable" by setting the No Build base line equal to 100%. It then creates bar charts on this basis. Since, none of the build scenarios renders a value less than 100%, the only difference among the alternatives that can be discerned is the small (compared to 100%) increment of improvement that the alternatives would create.

The DEIS text is clear: for labor and consumer markets, the performance measure is the average percentage increase in the number of people within a 30-minute drive time. For the buyer and supplier markets, the measure is the average percentage increase in the number of employed persons within 3 hours drive time. The DEIS text even provides a scale by stating that a 1% increase in labor and consumer markets represents approximately 1,250 people and a 1% increase in buyer and supplier markets represents an increase of 56,000 workers (see DEIS, pages 3-38 and 3-39).

Small percentage improvements represent thousands of people when converted into real numbers. Table 5.1 below summarizes these data for Alternative 1 (apparently, favored by the Report) and Alternative 3C, the preferred route selected by then Governor O'Bannon.

Table 5.1: Comparison of Business Accessibility Performance Measures for Alternatives 1 and 3C

	Alternative 1		Alternative 3C		3C vs. 1 (x better)
	Percent Improvement	Increase	Percent Improvement	Increase	
Labor/Consumer	0.55	688	3.76	4,700	6.8
Buyer/Supplier	1.52	85,120	3.84	215,040	2.5

Note: A 1% improvement in Labor/Consumer performance measure represents an increase of 1,250 people within a 30-minute drive time. A 1% improvement in the Buyer/Supplier performance measure represents an increase of 56,000 workers within a 3-hour drive.

Relative to each other – when one compares these two alternatives – the difference is huge. Preferred Alternative 3C increases the average labor and consumer market 3.76%, almost 7 times more than Alternative 1. The mean buyer and supplier market for Preferred Alternative 3C is 3.84%, 2.5 times more than Alternative 1.

Are these differences meaningful? Fortunately, there is a simple statistical test to answer this question. Using a student-*t* test, the DEIS reports that the business accessibility measures for I-70 alternatives (1, 2A, 2B, 3A, 4A, and 4B) versus the SR 37 alternatives (2C, 3B, 3C, 4C, 5A, and 5B) is significantly different at a 95% confidence level (see DEIS, page 3-39). The Report tries to obscure these stark differences by hiding them behind 100% of a "dimensionless variable" without offering any statistical evidence.

Traffic Safety

The Report also claims that there are no significant differences in the safety benefits between the alternatives and that the benefits of any alternative are less than 1% of total accident costs. They are correct with respect to the latter claim, but totally incorrect regarding the former. First, the "cost" of all crashes captured by the modeling system (which includes parts of other states and excludes crashes on most local jurisdictional roads) in the year 2025 assuming the No Build scenario is over $20 Billion (this is a complex calculation that includes "soft costs" such as life-long foregone wages, the cost of pain and suffering, etc. in addition to "hard costs" such as medical costs, repair costs, etc.) Using this number, the reduced safety costs of any alternative are less than 1% of the total. This should come as no surprise, because many crashes are due to driver and weather-related causes, not the design and volume conditions of the roads on which they occur.

Moreover, the Report misread the data that were provided to them. First, despite their assertion to the contrary, the total numbers of crashes (by type) were reported in the same files from which they tallied accident costs. Second, total accident costs were not in the vicinity of $6 Billion as they indicated, but rather $20 Billion. Further, total annual cost savings in 2025 (the difference between the No Build and the Build) – though less than 1% of total costs – differ markedly among the alternatives e.g., $176,000,000 for Preferred Alternative 3C versus $120,700,000 for Alternative 1.

Once again, from a traffic safety standpoint the SR 37 alternatives are statistically superior to the US 41 alternatives. The DEIS reports significantly different average crash reductions comparing these two groups at the 95% confidence level (page 3-36).

> *Despite the Report's assertion, made without evidence, that there is no difference among the alternatives in terms of traffic safety, the DEIS reports that the SR 37 alternatives provide statistically higher average crash reductions than the I-70 alternatives.*

Moreover, the data reported in the DEIS are for one year, only. When these annual safety improvements are accumulated over many years, they constitute significant benefits. For Preferred Alternative 3C versus the No Build option, it is estimated in the DEIS that about 1,574 serious crashes would be prevented per year by 2025. (A serious crash is defined as a traffic accident involving injuries and/or fatalities.) At this rate, it is reasonable to say that during the first 20 years of Preferred Alternative 3C's operation, over 31,000 fewer serious accidents would occur. This figure translates to over 40,000 persons that will not have to visit the emergency room (or the morgue). This figure is equivalent to the entire populations of Martinsville, Vincennes, and Washington combined.

Truck-Hours Saved

While we did not publish total daily truck-hours within the Study Area, the Report observes from data that we provided a figure of 1.1 million <u>total</u> truck-hours in the modeled area. This area includes large portions of Illinois – including much of Chicago – Michigan, Ohio, Kentucky and all of Indiana. It then casts the daily truck savings as a miniscule percentage - "less than one-half of one percent" – of this very large number.

In doing this, the Report ignores the fact that virtually *all* of the actual truck time savings will take place entirely within southwestern Indiana. Accordingly, if we change the denominator to a more appropriate number, the percentage savings would look significantly better. Total "No Build" truck hours in 2025 *within the I-69 Study Area is forecasted to be about 126,200 daily hours as opposed to 1.1 million.* Preferred Alternative 3C would save 4,300 daily truck-hours or about 3.4% - a number considerably larger than "less than one half of one percent".

Moreover, it should not go unnoticed that 4,300 truck-hours saved is more than twice as large as the 2,000 truck-hours saved by Alternative 1. Over the course of a year, this time savings translates into millions of dollars in business operating costs, which in turn contributes to a stronger economy.

Concluding Thoughts

The analysis in the DEIS deliberately embraced conservative assumptions. Had these assumptions been relaxed to what can very arguably be considered more realistic assumptions, the benefits of the alternatives would all have looked larger and so would the differences among them. This subject will be taken up in a later chapter.

At the end of the day, the many questions about costs and benefits that have been discussed in this and the preceding chapter inevitably lead to the question: do the benefits outweigh the costs? This is the question that will be taken up in Chapter 6.

VI. Benefit Cost Analysis

The Report ends its analysis by stating …

> While a properly executed cost-benefit analysis would greatly inform the judgment whether to pursue any of the I-69 alternatives, given the information currently available it would seem that, since none of the build alternatives provides significant benefits over the No-Build scenario, it would be unwise to make the large investment required to complete and maintain any of the project alternatives. (page 34)

Without conducting a benefit cost analysis themselves, the authors of the Report go on to say …

> However, if one were to select the best build alternative, based on the costs and benefits outlined above it would clearly be Alternative 1. (page 34)

In response to the Report we have conducted a formal benefit cost analysis for Alternative 1 and the Preferred Alternative 3C. This chapter will describe the analysis and report on its results. The chapter should also serve as a useful tool for "bringing together" the two preceding chapters on benefits and costs.

Observations About Benefit Cost Analysis

Before moving into the details of the analysis, it is appropriate to discuss some general considerations regarding the use of benefit cost analysis in transportation decision-making. This is a common tool that can be helpful at the planning level. It is part of INDOT's Major Corridor Investment Benefit Analysis System (MCIBAS), which is used in the statewide long-range transportation planning process. Benefit cost analysis is generally not used in NEPA studies for highway projects. In fact, the NEPA regulations specifically say that a cost benefit analysis is not required in a NEPA study.

Benefit cost or net present value measurements tend to become viewed as a "magic number", whether or not the analysts intend for it to be. The simple fact is that, for a decision as complex as the selection of a corridor for I-69 in Indiana, no single "magic number" can possibly exist. The decision must be based on a multitude of both performance and environmental factors, many of which simply cannot be measured in terms of dollars and cents.

Moreover, those who disagree with the results can always find some "methodological shortcoming" due to the sheer complexity of the analysis. The debates often focus on the social benefits and costs of environmental impacts (e.g., "I disagree with your monetary value of clean air!") Disputes also arise about what components of economic "benefits" should be incorporated (e.g., "Why did you include business attraction benefits when this activity is just being "stolen" from another part of the country?")

Type of Analysis: User Benefits and Costs

The most time-tested and least disputed type of investment or cost-effectiveness analysis for transportation projects is ***user benefit cost analysis.*** This is the kind of benefit cost analysis conducted for this report. This type of analysis tends to be more widely accepted than "economic" or "societal" benefit cost analysis, because it limits all benefits to those that accrue to the *users* of the transportation system and can be measured directly from travel demand model outputs.[1] Accordingly, by defining benefits and costs narrowly, the problem can be simplified somewhat. For example, user benefit cost analysis does not include economic benefits such as personal income growth. Similarly, it does not attempt to include the costs of environmental degradation save those that can be directly recognized, such as right-of-way and mitigation costs. (Mitigation costs include such things as the costs of wetlands and forest replacement.)

It is also generally viewed as a conservative type of analysis. In other words, if the results of the analysis produce a benefit cost ratio greater than 1.0 *without including any economic benefits*, the results tend to be less disputed.

User Benefits

User benefit cost analysis includes only traditionally unchallenged user benefits, namely: mobility or travel-time related benefits, vehicle operating benefits, and safety benefits.

Mobility Benefits and the Value of Time. A major component of the economic evaluation of any highway project relates to the amount of time that would be saved by motorists and commercial vehicles for each trip in the system under the assumption that the proposed project is built. Benefits accrue due to faster speeds on any highway segment that is upgraded (e.g., US 41 and SR 37) as well as traffic that diverts from slower facilities to the high speed Interstate.

The method used for calculating this user benefit includes the following features: (1) matrix based calculations using "congested skim times" (specifically, average daily speeds that include delay from traffic signal stops) and trip tables; (2) computation of travel times for base year build and no-build conditions and forecast year build and no-build conditions; (3) linear interpolation of intermediate-year values; (4) vehicle type-specific calculations for autos, single-unit trucks, and combination trucks; (5) application of varying unit values of time by type of vehicle and for work-related vs. non-work-related auto trips; (6) valuation of consumer surplus (i.e., longer trips in the build condition vs. no-build condition are valued at one-half the standard values of time), and (7) incorporation of all elements of induced demand in the build conditions (which adds to congestion and lowers speeds).

The unit values of time applied to the calculation of mobility benefits can be found in Table 6.1. These 1991 costs, which are recommended in FHWA's *Highway Economic Requirements*

[1] For a good discussion of the various types of benefit cost analyses, see *Transportation Research Record 1649*, "Comparing Approaches for Valuing Economic Development Benefits for Transportation Projects," Glen Weisbrod and Mike Grovak, 1998. Mr. Grovak is the consultant manager for the I-69 project.

System (HERS), are then updated to current dollars by way of the change in Consumer Price Index (CPI).

Table 6.1: Unit Value of Time (in 1991 dollars)

Trip Type	Work-Related Person Trips	Single-Unit Truck Trips	Combination Truck Trips
Unit Cost per Trip	$ 9.75	$ 14.88	$ 19.50

Source: Highway Economic Requirements System (HERS) with values for single-unit trucks and combination trucks updated in 2003

Safety Benefits and User Costs. User benefits associated with expected accident reductions attributable to a given alternative are estimated by computing the probable number and type of traffic crashes that would occur if the alternative were built versus the number and type of accidents assuming the status quo. Safety benefits occur, because divided, limited access facilities have lower crash rates than undivided facilities with little or no access control. The crash types are: (1) fatal crashes, (2) personal injury crashes, and (3) property damage only (PDO) crashes. Average cost factors associated with each crash type are then applied to the build versus no-build condition. The difference between the total crash costs with and without the highway represents the safety benefits of the project.

The crash rates used are borrowed from Tables A-37 through A-39 in *Microcomputer Evaluation of Highway User Benefits* (Texas Transportation Institute, NCHRP 7-12, October, 1993). The source of the crash rates in these tables was *The Highway Economic Requirements System (HERS)* and was developed by Jack Faucett Associates for FHWA in July, 1991. Crash rates are presented per one hundred million vehicle-miles of travel by facility type and by average daily traffic volume range. Due to the sensitivity of crash rates to traffic volumes, computations are made on a link-by-link basis for all links in the travel model network taking into account the loaded link volume and type of facility. These computations are made for both base year build and no-build conditions and forecast year build and no-build conditions. The cumulative differences between the no-build and build conditions represent the reduction in crashes in that year. Intermediate-year values are interpolated over the duration of the economic analysis period.

The accident cost factors used in the analysis are shown in Table 6.2. These 1991 costs are then inflated to current dollars in proportion to the ratio of the most recent average Consumer Price Index (CPI) versus the average of the 1991 CPI.

Table 6.2: Accident Costs (in 1991 dollars)

Accident Type	Fatal	Personal Injury	PDO
Unit Cost per Crash	$ 3,134,497	$ 74,637	$ 5,168

Source: *The Cost of Crashes,* Urban Institute, Final Report, June 1991.

Vehicle Operating Cost Benefits. The costs of operating a vehicle are influenced by a host of driving conditions as well as the type of vehicle, itself. Individual operating cost values are computed by vehicle type and by type of cost. The types of cost include:

- Fuel consumption
- Oil consumption
- Tire wear
- Vehicle maintenance
- Depreciation

These are computed for the following vehicle types:

- Small autos
- Medium/large autos
- 4-tire trucks
- 6-tire trucks
- 3+ axle, single unit trucks
- 3-4 axle combination trucks
- 5+axle combination trucks

The method used for computing vehicle operating costs incorporates the following features: (1) constant speed operating cost equations from the *Highway Economic Requirements System* (source: *HERS Technical Report* v 3.54, September 2003); (2) excess fuel consumption adjustment curves for acceleration/deceleration cycles based on link flow density; (3) excess operating cost curves due to speed variability (source: *HERS Technical Report* v 3.26, December 2000); (4) computations for both base year build and no-build conditions and forecast year build and no-build conditions, and (5) truck volumes derived from the Indiana Statewide Travel Demand Model's truck traffic assignments assuming a 75%-25% combination-single unit truck split with light vehicle fleet mix based on national data.

The costs for the five components and the excess costs are adjusted to current dollars based on consumer and producer price indices specific to each cost component. Consumer price indices are used for all auto costs, as well as single-unit trucks' fuel and maintenance for both classes of trucks. Producer price indices are used for all the remaining truck cost components.

A unique feature of this analysis is the excess fuel consumption adjustment curves for driving cycles based on link flow density. Ordinarily, benefit cost analysis bases vehicle operating costs on the simplifying assumption that traffic operates at the constant average speed (i.e., without speed fluctuations) associated with each link in the network. In this analysis, excess fuel consumption resulting from frequent accelerations and decelerations associated with the level of traffic congestion on each link has been incorporated. These curves were developed by BLA based on EPA fuel consumption rates for highway and city driving and calibrated to replicate actual flow conditions as output by the Indiana Statewide Travel Demand Model. Excess costs due to stops and starts at traffic signals are also incorporated.

Another feature of the analysis is the incorporation of topographical impacts on vehicle operating conditions in southwestern Indiana. Operating costs vary depending on the vertical grade of the road with the impact being more severe for trucks. Table 6.3 shows the percentage differences in total operating costs for varying grades as compared to costs on level terrain. Values from this table were incorporated into the analysis.

Table 6.3: Percentage Difference in Vehicle Operating Costs on Grades

Speed (mph)	Grade (%)								
	-4	-3	-2	-1	0	1	2	3	4
5	88.72%	88.70%	92.02%	94.40%	100.00%	108.38%	122.49%	130.98%	154.72%
10	85.60%	86.46%	86.24%	93.39%	100.00%	114.07%	126.05%	139.17%	157.31%
15	82.38%	84.67%	86.94%	92.79%	100.00%	119.79%	129.57%	147.68%	158.47%
20	79.02%	80.88%	82.17%	91.53%	100.00%	119.51%	133.13%	152.84%	171.35%
25	75.75%	78.56%	82.04%	90.05%	100.00%	120.76%	134.39%	153.05%	174.30%
30	73.43%	76.93%	80.85%	89.71%	100.00%	120.26%	135.07%	155.15%	177.85%
35	71.33%	75.58%	79.61%	89.89%	100.00%	118.88%	135.46%	156.92%	182.52%
40	70.80%	74.75%	82.25%	91.58%	100.00%	118.85%	137.24%	159.45%	192.17%
45	70.36%	74.97%	80.52%	91.15%	100.00%	118.34%	137.91%	161.47%	n/a
50	n/a	69.73%	82.61%	92.48%	100.00%	118.68%	137.88%	n/a	n/a
55	n/a	76.33%	83.08%	92.95%	100.00%	119.00%	n/a	n/a	n/a
60	n/a	n/a	83.71%	91.87%	100.00%	116.82%	n/a	n/a	n/a

Source: *A Manual on User Benefit Analysis of Highway and Bus-Transit Improvements*, American Association of State Highway and Transportation Officials, 1977.

Costs

Costs include all construction-related costs as well as ongoing operation and maintenance (O&M) costs.

Construction-Related Costs. The construction-related costs include: construction, design and right-of-way engineering, right-of-way acquisition costs, environmental mitigation costs, and rest area costs (including land acquisition). **These cost figures are more inclusive than what was previously published in the DEIS, in that they include the addition of the mitigation and rest area costs. These new costs are included in the FEIS.** These costs are invested early in the analysis period and therefore are not as deeply discounted as the stream of user benefits, which do not even begin until the construction costs have been fully spent.

Operation and Maintenance Costs. O&M costs include annual maintenance and public safety that begin when the highway opens and continues throughout the economic life of the project. Consequently, these costs are discounted to the same degree as the flow of benefits. The O&M costs consist of annual maintenance cost and annual public safety cost. Annual maintenance costs increase with additional lane mileage and annual public safety costs increase with additional centerline miles. In recent Indiana studies, the following unit costs have been used.

Added maintenance cost/lane mile (Interstate Highways)	$2,900
Added maintenance cost/lane mile (non-Interstate Highways)	$3,100
Added operating cost/center-line mile (all highways)	$13,000

Analysis Components and Assumptions

There are a number of additional considerations regarding benefit cost analysis that have a major effect on the results. Factors include such things as: the discount rates, the length of the analysis period and timing of construction, the residual value, and the presence or absence of induced travel demand. This section will document these factors.

Timing. Benefit cost analysis assumes that there will be no user benefits until the highway is open to traffic. In other words, there are no partial user benefits that begin to flow as sections are open. In this case, it is assumed that construction will begin in 2007 and will continue over a 10-year period. Due to the impracticality of running separate travel model runs for different sections of the highway that might reasonably be expected to be open to traffic before the end of the 10-year construction period, **the operative assumption for this analysis is that benefits will begin to flow in the seventh year of construction.** This is based on the reasonable assumption that certain sections may be open as early as 3 years into the 10-year construction period.

Discounting and the Discount Rate. In benefit cost analysis all benefits and costs are discounted back to the year in which construction is assumed to begin. The discounting of costs is done, because if the total capital costs for the entire project were invested in 2007, the amount of funds needed for the investment would be less than the total construction amount due to the income that would be earned over the construction period. Discounting of benefits is done, because of the "opportunity cost" associated with giving up benefits that might have been derived from other competing public investments.

Traditionally, the benefit and cost streams are discounted at the same rate. Standard practice calls for the selection of a discount rate approximately equal to a reasonable expected rate of return on an investment. **The Office of Management and Budget recommends that a rate of *7%* be used for benefit cost analysis.** (In order to avoid the complicating effects of inflation, the analysis uses the standard assumption that all costs and benefits are in constant dollars.)

A distinction should be made between benefit cost analysis – which establishes a discount rate on the basis of a reasonable return on investment – and cost effectiveness analysis. Benefit cost analysis focuses on whether or not the proposed action represents a reasonable investment of public funds. Cost effectiveness analysis, however, focuses on a slightly different question, namely: is the project effective? In other words, do the benefits outweigh the costs of raising the capital to pay for the project. Since interest rates are very low at this point in history, the cost of capital is a much lower rate than the 7% rate of return. Accordingly, **we are also conducting the**

the analysis in this chapter at a discount rate of 4% to represent a cost-effectiveness analysis.

Length of the Analysis Period. Standard time periods for benefit cost analysis are around 25-30 years. For the purposes of this analysis, we are using a 30-year analysis period. Beyond 30 years, the benefit stream is so deeply discounted that additional years add very little to the results.

Residual Value. After 30 years, the highway will still be in place and will still be serving the motoring public. In other words, the project will still have an ongoing useful life. This is commonly referred to as the "residual value" of the project. This residual value is estimated and its discounted value is netted out of the cumulative discounted cost stream (i.e., discounted construction-related and O&M costs).

Estimation of the project's residual value is based on typical highway life cycle costs for five major capital cost components. These cost components and their useful lives are listed below…

❖ Right-of-way	Infinite life
❖ Earthwork	100 years
❖ Structural costs	70 years
❖ Road base	50 years
❖ Other	30 years

With this life cycle information, the residual value of both alternatives (i.e., "1" and "3C") was computed based on the 30-year analysis period. For example, the residual value of the project's earthwork was computed as: (100 year useful life minus 30 year analysis period) divided by the 100-year useful life. This computation yields a multiplier of 0.7, which was applied to the total earthwork cost of the project. Working out this math for each component, the specific percentage of the individual major cost components included in the residual value is as follows: 100% of the real estate value; 70% of the earthwork; 60% of the structural costs; 40% of road base work, and 0% of pavement and other costs.

Induced Demand. Since I-69 will induce travel that would not occur if it is not built, this additional induced travel demand has been included in the forecast year runs. Induced demand includes: (1) longer trips due to altered destination choices, (2) additional travel due to economic development stimulated by the highway, and (3) new travel passing through the Study Area due to the presumed eventual construction of I-69 nationally.

The inclusion of induced demand has the effect of reducing benefits, since it increases VMT which: (1) adds vehicle operating costs; (2) lowers speeds thus increasing travel times, and (3) raises flow densities thus further increasing operating costs.

Benefit Cost Analysis Results

The results of the benefit cost analysis are summarized in Tables 6.4 and 6.5. The values in Table 6.4 are all *undiscounted*. (Note that all values are in thousands.) Clearly, when one considers costs alone, Alternative 1 has a large advantage over Preferred Alternative 3C. The latter's construction-related costs are nearly twice as large as the former.[2] Moreover, annual operation and maintenance costs for Preferred Alternative 3C are ten times more than Alternative 1. This is due to the fact that Alternative 1 is entirely on an existing highway where costs are already being expended; whereas, Preferred Alternative 3C includes many miles of new roadway.

> *Regardless of the discount rate, Alternative 1 has a negative net present value.*

The three elements of user benefits are also included in Table 6.4. When one considers benefits, Alternative 1 loses its advantage over Preferred Alternative 3C. The forecast year (2025) annual mobility benefits (undiscounted) for Preferred Alternative 3C are over three times larger than the mobility benefits for Alternative 1. Preferred Alternative 3C's safety benefits are more than 45% greater than Alternative 1's. Vehicle operating benefits are negative numbers in both cases. These disbenefits are typical of large projects that allow greatly improved operating speeds. In both cases, the improvement in driving conditions (e.g., fewer stops and starts, more constant-speed cruising) is not enough to make up for the more expensive vehicle operating costs associated with higher speeds.

Table 6.4 – Alternatives 1 and 3C: Undiscounted Costs and Benefits (x $1,000)

	Construction-Related Costs	Annual O&M Costs	2025 Mobility Benefits	2025 Vehicle Operating Benefits	2025 Safety Benefits
Alternative 1	$993,280	$288	$45,392	- $124,764	$120,700
Alternative 3C	$1,885,770	$2,597	$137,371	- $107,137	$176,384

Table 6.5 summarizes the bottom-line numbers of the analysis. In this table, the numbers have all been fully discounted to present value. The results are presented for both a 7% discount rate and a 4% discount rate. Recall that 7% is the rate recommended by the Office of Management and Budget for formal benefit cost analysis. The 4% rate is more appropriate (at this point in history) for a cost-effectiveness analysis due to the low cost of capital.

Regardless of the discount rate, Alternative 1 has a negative net present value. This means that when all discounted costs are subtracted from all discounted user benefits, the costs are larger than the benefits and the benefit/cost ratio is less than 1.0. On the other hand, Preferred

[2] Construction costs are larger for both alternatives than the DEIS costs. These revised figures now include environmental mitigation costs plus the cost of rest areas. In the case of Preferred Alternative 3C, a relatively small additional amount has been added to include a new grade-separated bridge across I-69 in southern Marion County and additional costs for the interchange with I-465.

Alternative 3C has a positive net present value of nearly $140 million for the 7% benefit cost analysis and over $1 billion for the 4% cost effectiveness analysis. The benefit/cost ratio for Preferred Alternative 3C is greater than 1.1 using a 7% discount rate and nearly 1.8 using a 4% discount rate.

The results of this analysis have led to the exact opposite conclusion…on the basis of user benefit cost analysis, "3C" should be built.

The reader will notice that the discount rate has a disproportionately greater effect on user benefits than costs. This is because benefits are more deeply discounted given the fact that they occur later in time. Whereas, costs are not as deeply discounted, since the construction-related costs all occur at the beginning of the analysis period.

Table 6.5 – Discounted Value of Benefits and Costs: 7% and 4% (x $1,000)

	Discount Rate	Total User Benefits	Total Costs Less Residual Value	Net Present Value	Benefit Cost Ratio
Alternative 1	7%	$303,374	$696,387	-$393,013	0.436
	4%	$479,276	$689,792	-$210,516	0.695
Alternative 3C	7%	$1,464,635	$1,325,370	$139,264	1.105
	4%	$2,346,320	$1,306,610	$1,039,710	1.796

Conclusions

This chapter began by quoting from the Report*,* which contended that a benefit cost analysis would inevitably lead to the conclusion that – if any alternative passed the test – it would be Alternative 1. In this chapter, formal user benefit cost analysis has been conducted for Alternative 1 and Preferred Alternative 3C, the route selected by then Governor O'Bannon. The results of this analysis have led to a conclusion that is exactly opposite of the one alleged in the Report. Of the two alternatives analyzed, "3C" is the one that should be built on the basis of user benefit cost analysis. This finding is based solely on user benefits. If macroeconomic benefits were taken into account, all of the alternatives would have higher benefits and the differences between the alternatives would increase.

VII. Different Assumptions About Committed Projects

Chapter 4 introduced the argument put forward in the Report that two assumptions made in the DEIS had the effect of biasing the analysis against Alternative 1 (the US 41 – I-70 corridor). Specifically, the Report alleged that:

(1) if the benefits derived from the planned added lanes on I-70 had been counted as benefits attributable to Alternative 1, this alternative would have been able to compete on a more equal footing with the other alternatives, and;

(2) if the planned improvements to SR 37 had been treated as "committed" projects (i.e., projects that will definitely be built irrespective of I-69), the alternatives that make use of SR 37 would not have performed as well.

With respect to both of these arguments, the Report did not consider the cost implications of these alternative assumptions. Simply put, the cost of Alternative 1 and all the other alternatives that make use of I-70 would have gone up, while the costs of the alternatives that use SR 37 would have gone down. These cost implications were discussed in Chapter 4, which concluded that – from a cost perspective – the DEIS assumptions show in the most favorable light Alternative 1 and routes that make use of I-70 and work to the detriment of the SR 37 routes.

Chapter 4 leaves unresolved the Report's question about the *benefits* of the altered assumptions. More relevantly, how would the benefits have changed *in relation to the cost changes?* These questions are addressed in this chapter.

Assumption Regarding Committed I-70 Improvements

In this section, we will analyze the effect of changing the DEIS's assumption with respect to added lanes on I-70 in terms of its effect on Alternative 1's benefit cost analysis. For example, would Alternative 1's benefits have improved enough to offset the cost increase if we had attributed the additional capacity on I-70 to Alternative 1? The Report's assertion implies that the increment of additional benefits *would* outweigh the added costs.

> *There remains another question the Report did not think to ask: how would the effect of <u>not</u> building the added capacity on I-70 affect Alternative3C's benefit cost analysis?*

However, our analysis does not stop there. Assuming for the sake of argument that the Report is correct in its implied position that the added benefits would outweigh the added costs, there remains another question they did not think to ask, namely: how would the effect of *not* building the added capacity on I-70 affect Preferred Alternative 3C's benefit-cost relationship? If added lanes on I-70 are defined as part of Alternative 1, then this redefined project must compete with other alternatives in which the added I-70 lanes are *not* built. In this case, the No Build assumption must be that the capacity on I-70 that exists today would not increase unless Alternative 1 is built. This sets up a situation in which there is the potential for greater diversion from a highly congested I-70 to the non-I-70 alternatives that run more-or-less diagonally between Evansville and Indianapolis. For reasons of practicality, we will limit our evaluation of the revised I-70 assumption to a comparison of the revised benefit cost analysis for Alternative 1 with the revised benefit cost analysis for the FEIS's preferred corridor – Alternative 3C.

For ease of reference, we will refer to the DEIS's working assumption with respect to I-70 as Scenario A. In this case, added lanes on I-70 are committed to be built regardless of the I-69 alternative that is chosen. Therefore, neither the cost nor the benefits associated with adding those lanes is attributed to either Alternative 1 or Preferred Alternative 3C. **Scenario A reflects the set of assumptions in the benefit cost analysis in the preceding chapter. (Note: All cost data in this and the preceding chapter use updated costs as shown in the FEIS.)**

Scenario B will refer to the assumption advocated in the Report: that the added lanes on I-70 should be treated as a part of Alternative 1, not as an independent, committed project. In this case, all the benefits and all the costs associated with building these lanes will be attributed to Alternative 1. At the same time, under Scenario B there is the potential for greater benefits to accrue to Preferred Alternative 3C, since there may be greater diversion to this alternative due to the restricted capacity of I-70. Moreover, it should be noted that Scenario B implies no added costs for Preferred Alternative 3C.

Scenario B: Benefit Cost Analysis Results. All assumptions in this benefit cost analysis are the same as those described in Chapter 6. Table 7.1 shows the construction-related and O&M costs associated with both alternatives under both Scenario A and Scenario B. The latter set of costs is assumed for this benefit cost analysis. In Scenario B construction-related costs for Alternative 1 are $310 million more than they are in Scenario A. Similarly, annual operation and maintenance costs go up $319,000. The costs of Preferred Alternative 3C remain unchanged.

Table 7.1 – Undiscounted Costs for Alternatives 1 and 3C: Scenarios A and B (x $1,000)

	Scenario A		Scenario B	
	Construction-Related	Annual Operation & Maintenance	Construction-Related	Annual Operation & Maintenance
Alternative 1	$993,280	$288	$1,303,280	$607
Alternative 3C	$1,885,770	$2,597	$1,885,770	$2,597

Table 7.2 summarizes the results of the benefit cost analysis for Scenarios A and B, assuming a 7% discount rate (which the Office of Management and Budget recommends for true benefit cost analysis). As the table shows, assuming Scenario B the analysis vindicates the Report's position

that total discounted benefits would increase more than total discounted costs for Alternative 1. Total user benefits increase approximately $746.8 million, whereas total discounted costs (less residual value) increase only $216.2 million. Moreover, under Scenario B, Alternative 1 now exceeds a benefit/cost ratio of 1.0 and shows a net present value of $137.6 million. **This represents an increase in net present value for Alternative 1 of $530.6 million.**

However, Table 7.2 also shows an increase in the performance of Preferred Alternative 3C due to greater diversion to the new highway from the more congested I-70 corridor. Under the same set of assumptions regarding the treatment of I-70, Preferred Alternative 3C experiences a boost of $696.1 million in total user benefits – about $50 million less than Alternative 1. While this is not as large an improvement in benefits as Alternative 1 gets under Scenario B, since the costs of Preferred Alternative 3C have nothing to do with I-70, total costs (less residual value) are exactly the same as they are under Scenario A. Consequently, **Preferred Alternative 3C's net present value rises from $139.26 million to $835.4 million – an increase of $696.13 million.**[1]

The bottom line is that Preferred Alternative 3C gets a larger boost from the assumption that added lanes on I-70 is a part of Alternative 1 than Alternative 1 does.

Table 7.2 – 7% Discounted Value of Benefits and Costs for Alternatives 1 and 3C: Scenarios A and B (x $1,000)

	Scenario	Total User Benefits	Total Costs Less Residual Value	Net Present Value	Benefit Cost Ratio
Alternative 1	A	$303,374	$696,387	-$393,013	0.436
	B	$1,050,196	$912,610	$137,586	1.151
Alternative 3C	A	$1,464,635	$1,325,370	$139,264	1.105
	B	$2,160,767	$1,325,370	$835,397	1.630

The "bottom line" is that Preferred Alternative 3C gets a larger boost out of the assumption that added lanes on I-70 should be included in the definition of Alternative 1 than Alternative 1 does.

Assumption Regarding Uncommitted SR 37 Improvements

In this section, we will analyze the effect of changing the DEIS's assumption with respect to planned improvements on SR 37 in terms of its effect on benefits and costs. **In this scenario – which we will refer to as Scenario C – planned improvements along SR 37 will be treated as "committed" as recommended in the Report.** These improvements include the elimination of

[1] It is important that the reader not fall into the technical trap of comparing the change in the benefit/cost ratios between scenarios. A direct comparison of the change in ratios cannot be made since their respective denominators are different. What is important is the change in net present value (i.e., discounted total user benefits minus discounted total costs).

at-grade intersections replaced with grade-separated, directional interchanges in the Bloomington area. These are a part of the Bloomington's Long Range Transportation Plan. They also include projects in INDOT's Long Range Transportation Plan that would add lanes on SR 37 from I-465 to SR 144. (These INDOT projects do not include the replacement of intersections with interchanges.) With these projects treated as "committed", the costs of Preferred Alternative 3C go down, while the costs of Alternative 1 remain unchanged from Scenario A.

Scenario C Benefit Cost Analysis Results. All assumptions in this benefit cost analysis are the same as those described in Chapter 6. Table 7.3 shows the construction-related and O&M costs associated with Alternatives 1 and 3C under Scenario A, Scenario B, and Scenario C. All three scenarios are shown together for ease of comparison. In Scenario C, construction-related costs for Preferred Alternative 3C decline from the FEIS's assumption (Scenario A) by $170.2 million to $1.706 billion. Similarly, annual O&M costs decline by $61,000. In this case, the costs of Alternative 1 are unchanged from Scenario A.

Table 7.3 – Undiscounted Costs for Alternatives 1 and 3C: Scenarios A, B and C (x $1,000)

	Scenario A		Scenario B		Scenario C	
	Construction-Related	Annual Operation & Maintenance	Construction-Related	Annual Operation & Maintenance	Construction-Related	Annual Operation & Maintenance
1	$993,280	$288	$1,303,280	$607	$993,280	$288
3C	$1, 885,770	$2,597	$1,885,770	$2,597	$1,715,770	$2,536

In Scenario C, total discounted user benefits decline from Scenario A: approximately $78 million for Alternative 1 and $197.5 million for Preferred Alternative 3C. However, as noted above, the costs for Preferred Alternative 3C decrease, while the costs for Alternative 1 remain unchanged (relative to Scenario A).

Table 7.4 – 7% Discounted Value of Benefits and Costs for Alternatives 1 and 3C: Scenarios A, B and C (x $1,000)

	Scenario	Total User Benefits	Total Costs Less Residual Value	Net Present Value	Benefit Cost Ratio
Alternative 1	**A**	$303,374	$696,387	-$393,013	0.436
	B	$1,050,196	$912,610	$137,586	1.151
	C	$225,396	$696,387	-$470,991	0.324
Alternative 3C	**A**	$1,464,635	$1,325,370	$139,264	1.105
	B	$2,160,767	$1,325,370	$835,397	1.630
	C	$1,267,102	$1,207,208	$59,894	1.050

The combined effect of these benefit and cost changes is a decline in net present value of $77.98 million for Alternative 1 and nearly an identical amount for Preferred Alternative 3C: $79.4 million. While the change in net present value is virtually the same for Alternatives A and 3C, it should not go unnoticed that Preferred Alternative 3C remains above the point of "economic indifference" (i.e., benefit/cost ratio of 1.0), whereas the benefit/cost ratio for Alternative 1 goes from an unacceptable value in Scenario A (0.436) to an even worse value in Scenario C (0.324).

Conclusions

Contrary to the Report's contention that Alternative 1 was unfairly treated in the DEIS, this chapter reveals very different results. Using the analytical method that the Report recommends (i.e., benefit cost analysis), Alternatives 1 and 3C were re-evaluated under two modified sets of assumptions with respect to what are considered "committed" projects. Embracing the two sets of assumptions that the Report insists should have been used in the DEIS, we have conducted in this chapter two revised sets of benefit cost analyses. These are contrasted with the benefit cost analysis documented in the previous chapter, which we refer to as Scenario A.

> *In the final analysis, regardless of which set of assumptions is embraced, the benefit-cost results for Alternative 3C are far superior to Alternative 1.*

For ease of reference the DEIS's baseline assumptions and the two revised assumptions are shown below…

- **Scenario A** – The DEIS assumption that two added travel lanes (one in each direction) on I-70 between SR 641 in Terre Haute and I-465 in Indianapolis is committed by INDOT. In this case, benefits and costs associated with the I-70 improvement do not accrue to any of the I-69 alternatives. Scenario A also assumes that planned improvements to SR 37 between Bloomington and Indianapolis are not committed.

- **Scenario B** – The Report's recommendation that the added travel lanes on I-70 should be treated as uncommitted, thus increasing the benefits and costs accruing to Alternative 1.

- **Scenario C** – The Report's recommendation that planned improvements to SR 37 between Bloomington and Indianapolis be treated as committed, thus reducing the benefits and costs associated with Preferred Alternative 3C.

In summary, Scenario B improves the net present value of Alternative 1 over Scenario A. Moreover, under this scenario Alternative 1 becomes economically viable (i.e., its benefits outweigh its costs). However, the set of assumptions used in Scenario B improves the net present value of Preferred Alternative 3C even more than it does for Alternative 1. This is due to greater diversion from a congested 4-lane I-70 to Preferred Alternative 3C than would occur if I-70 has six lanes.

Scenario C reduces the net present value of Preferred Alternative 3C. However, the net present value of Alternative 1 is diminished by almost the exact same amount, largely because the cost of Preferred Alternative 3C is reduced, whereas the cost of Alternative 1 remains unaffected by this scenario.

In the final analysis, the DEIS assumption with respect to I-70 accrued to the benefit of Alternative 1. Altering the DEIS assumption regarding improvements on SR 37 has essentially the same effect on both alternatives. Regardless of which set of assumptions is embraced, the benefit-cost results for Preferred Alternative 3C are far superior to Alternative 1.

VIII. Other Issues Raised in the Report

This chapter addresses five other issues raised in the Report that are of lesser importance than the issues discussed in the preceding chapters. Each of these five issues will be discussed in turn.

Misclassified Links

The Report correctly points out that five links in the transportation model – out of approximately 16,000 – were incorrectly coded as being inside the 26-county Study Area when in fact they are not. Interestingly, they were correctly coded for Alternative 1, but the mistake apparently occurred for all the other alternatives.

This error affects the values of six congestion performance measures used in the DEIS. They have been re-computed and the new values will be published in the FEIS. The corrected values also reflect changes in the alignment of the SR 37 alternatives to show the abandonment of the Mann Road variation just south of I-465 in favor of staying on SR 37. They also reflect a shift in the location of where Alternative 3B would tie into SR 37 on the north side of Bloomington. Tables 8.1 and 8.2 provide the original DEIS and the re-computed FEIS numbers for these six performance measures.

Table 8.1: DEIS Study Area Congestion Performance Measures

	1	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B
V/C on Major Highways	0.89	0.88	0.87	0.86	0.87	0.86	0.86	0.87	0.87	0.86	0.87	0.86
% Congested Road Lane-Miles	9.79	9.63	9.46	9.28	9.45	9.46	9.17	9.42	9.45	9.34	9.45	9.25
% Congested VMT	34.03	33.93	33.75	33.13	33.94	34.19	33.04	33.83	33.93	33.50	33.78	33.10
% Congested VHT	57.81	57.96	57.82	57.34	57.59	57.65	57.19	57.51	57.80	57.49	57.52	57.21
% VHT in Delayed Conditions	68.54	68.69	67.27	66.67	67.04	66.75	66.89	67.34	67.59	66.71	67.62	66.87
ESPI by VHT	7.915	7.896	7.994	8.064	8.024	8.039	8.059	8.01	7.975	8.052	7.979	8.059

Table 8.2: FEIS Study Area Congestion Performance Measures

	1	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B
V/C on Major Highways	0.89	0.88	0.87	0.87	0.87	0.87	0.86	0.87	0.87	0.86	0.87	0.86
% Congested Road Lane-Miles	9.79	9.69	9.52	9.42	9.51	9.47	9.27	9.48	9.51	9.41	9.51	9.33
% Congested VMT	34.03	34.08	33.90	33.67	34.08	34.23	33.41	33.97	34.07	33.87	33.91	33.40
% Congested VHT	57.81	58.16	58.01	57.91	57.78	57.92	57.63	57.68	57.98	57.92	57.89	57.70
% VHT in Delayed Conditions	68.54	68.89	67.47	66.61	67.23	66.96	67.27	67.52	67.78	67.05	67.79	67.23
ESPI by VHT	7.914	7.871	7.969	8.031	8.000	8.007	8.007	7.987	7.952	8.002	7.956	8.005

As a comparison of the two tables shows, the differences are minor. The basic relational patterns among the alternatives as discussed in the DEIS remain essentially unchanged.

Percentage of Congested Roadway Lane-Miles

The Report takes issue with the use of "percentage of congested road lane-miles" as a performance measure, pointing out that in two instances the actual number of congested lane-miles increases slightly relative to the No Build scenario. The use of this variable is well justified when one considers that the total *number* of lane-miles changes significantly among the alternatives. Accordingly, the use of a percentage it necessary to take into account the change in the denominator.

Moreover, one of the reasons that the DEIS makes use of several measures whenever possible to quantify relative goals achievement (even for a single goal) is to avoid the situation of being totally reliant on a single variable. Decisions were made on the preponderance of the evidence provided by more than one measurement.

Economic Winners and Losers

The Report correctly points out that the DEIS typically does not provide a breakdown of economic data for each alternative by region. We acknowledge this fact and are providing region-level data in the FEIS. These data will be available in Tables 3-26A through 3-26E of Section 3.4.

While these tables are not provided here, an examination of the data reveals two important facts. First, despite statements made by some residents of the Terre Haute region (Vigo and Clay counties) that they would be economically hurt by alternatives that do not directly serve them, the data reveal that *there are no net economic losers* in the Study Area. All regions benefit from each alternative to varying degrees. Second, some of the better performing alternatives provide almost as much benefit to the Terre Haute region as Alternative 1. For example, the Preferred Alternative 3C will generate in the range of 80-90% of the benefits that Alternative 1 would provide for such economic measures as personal income and employment growth.

Redistribution of Economic Growth

The Report puts forth the argument that at least to some extent, new highways redistribute economic growth. In other words, some growth takes place at the cost of it not happening elsewhere. This is the very nature of much economic policy (jobs programs, transfer payments, tax reform, economic development programs, etc.) and it is well within the province of representative government to make those judgments and implement programs that redistribute wealth. At the same time, it is illogical to maintain that capital investment does not lead to overall economic growth. Transportation investment leads both to overall growth, as well as influences where growth occurs.

Distribution of Economic Benefits

The Report points out that despite the reported increase in disposable personal income, there would be no increase in *per-capita* disposable personal income due to net population in-migration. The Report cannot be faulted for making this statement, because the numbers are

INDOT's and FHWA's in the first place. However, the reason why per-capita personal income was dropped as a performance measure early in the study process is because of the technical limitations of the modeling process to correctly compute this variable. All modeling processes have their limitations – including the one's employed by INDOT and FHWA. One such limitation in the MCIBAS-REMI process is that birth rates and labor force participation rates are not allowed to change in response to economic change; these two variables remain unaffected, whereas virtually all other variables in the modeling system are allowed to change. In other words, the system sets up a "zero sum game" in which couples cannot elect to have more or less children and people cannot decide to enter the labor force even when new jobs are created. Therefore, in response to a job created, someone must either migrate into the region (at the loss of another region) or remain in the region who would have otherwise left. This sets up a process in which it is very difficult to compute a meaningful change in per-capita income. In reality, we know that local labor force participation rates *do* respond to economic gains and losses in a region. So, the fact is that even though the technical process is incapable of computing it, when total real disposable income is created, the potential exists for per-capita income to increase as well.

In response to this issue, we have conducted a longitudinal analysis of rural counties in Indiana to learn what historical per-capita income infers about this question. For this analysis 56 counties were classified as rural based on a maximum population threshold of 40,000 in the 2000 Census. Of these 56 counties, 35 counties do not have direct access to an Interstate, while 21 counties do have Interstate access. Historical per-capita income data were compiled for all 56 counties for the years 1971 through 2001. In order to eliminate the illusion of per-capita income growth from inflation, all data were converted into constant 2001 dollars. The counties without Interstates experienced constant dollar per-capita income growth of 41% during the 31-year period. The counties with access to Interstates grew 48.2% during the same period.

Table 8.3: Two-Sample One-Tailed *t*-Test With Unequal Variances – Per-Capita Income Growth for Rural Indiana Counties, 1971-2001

	$ change (1971 -2001) – ***Interstate Hwy.***	*$ change (1971 -2001) –* ***No Interstate Hwy.***
Mean	**7788.113834**	**6560.970258**
Variance	11475540.56	6061286.823
Observations	21	35
Hypothesized Mean Difference	0	
Df	33	
t Stat	1.446570354	
Prob true t-Stat>t-Stat	0.078724857	
t Critical one-tail (0.10 alpha; 90% confidence)	1.307737421	
t Critical one-tail (0.05 alpha; 95% confidence)	1.692360456	

In order to determine whether or not this apparent differential in percentage growth is real, a *t*-test of the average 1971-2001 growth in real dollars (not percent) was conducted between the two groups of counties. Due to the large variance in both data sets, it is not possible to reject the null hypothesis at the 95% confidence level. However, at the 90% confidence level, the null hypothesis can be rejected. Table 8.3 contains the results of this analysis for both confidence levels.

In other words, we can say with 90% confidence – although, not 95% confidence – that there was higher real dollar per-capita income growth between 1971 and 2001 in rural Indiana counties that have direct access to an Interstate highway than rural Indiana counties that do not have direct access to an Interstate highway.

Further, it should be pointed out that even though INDOT and FHWA elected not to use them as performance measures, there are other measures of increased regional wealth that I-69 would generate, for example: annual net change in business sales. A couple of illustrative examples: $812,000,000 (in constant 2001 dollars) of additional business sales would be generated by Preferred Alternative 3C in the forecast year 2025 versus $245,000,000 that would be generated by Alternative 1. Even though increased business sales is a real benefit, these were not published or otherwise relied on in the decision-making process, since we wanted to avoid double counting and we believe that real disposable personal income is a preferable measure of local economic benefit.

IX. Closing Thoughts: Conservative Nature of the DEIS Analysis

It is not uncommon for the benefits attributed to a transportation project to be called into question by those who oppose the project. Accordingly, a conscious decision was made in the early phases of the *I-69 Evansville to Indianapolis Tier 1 Draft Environmental Impact Statement* to exercise great caution in forecasting the project's benefits. Wherever judgments had to be made regarding assumptions that would influence the outcome of the performance measures, typically conservative assumptions were used. In at least one case, there are now federal data available to corroborate the fact that one of the important model components probably was conservative: the trucking forecasts.

This chapter will document several instances of conservative judgments and forecasts that – if traded for more liberal assumptions – would have resulted in significantly larger estimates of many performance measures. Moreover, *with these more liberal forecasts, it is likely that the differences among alternatives for certain performance measures would have been larger as well.*

What the *Freight Analysis Framework* Suggests about Truck Forecasts

In 2002, the Federal Highway Administration unveiled its Commodity Flow Database. This new database is part of FHWA's *Freight Analysis Framework* (FAF), which has been made available for national, statewide, and metropolitan planning purposes. It contains trip table forecasts of commercial tonnage by mode to the year 2020.

Table 9.1 – Total Domestic Truck Tonnage with One or Both Trip Ends Inside Indiana: 1998, 2010, and 2020

1998	2010	2020
499,278,263	698,524,370	819,623,522
% Increase from 1998	39.9	64.2

Source: Commodity Flow Database, *Freight Analysis Framework*, U.S.DOT, Federal Highway Administration, Office of Operations, 2002.

An examination of FAF's Commodity Flow Database reveals startlingly high forecasted growth rates in commercial tonnage for most of the country. Table 9.1 shows the expected growth in truck tonnage for domestic, *Indiana-based trips* from 1998 to 2010 and 2020. These data do <u>not</u> contain data on truck tonnage moving through Indiana – only trips that have an origin and/or destination in Indiana. They also exclude any international truck tonnage.

Over a 22-year period, these data suggest that truck tonnage will grow over 60% in Indiana. This translates into an annual compounded growth rate of nearly 2.28%. By contrast, the Indiana Statewide Travel Demand Model (ISTDM) shows a forecast in total truck vehicle-miles of approximately 37.9% over 27 years (1998-2025). This represents an annual, compounded growth rate of about 1.198%.[1]

While INDOT and FHWA have not officially embraced the commodity flow forecasts from FAF, it is almost certain that the upcoming version of ISTDM expected in early 2004 will show significantly higher truck forecasts than those which were used in the I-69 Purpose and Need as well as the alternatives analysis. Accordingly, we believe that the updated I-69 forecasts that will be developed for the I-69 Tier 2 studies will show significantly higher traffic forecasts. Had these been available for the I-69 alternatives analysis, it is almost a certainty that there would have been no debate about the committed status of added lanes on I-70. Moreover, with higher forecasts the differences among the alternatives would also have been more pronounced.

Economic Analysis

In Chapter 3 of this report, Figure 3.1 depicts a flow diagram of the integrated analytical system that was used for conducting the transportation planning aspects of the I-69 alternatives analysis. As the diagram shows, highway user benefits (i.e., travel time-related benefits, vehicle operating benefits, and safety benefits) are computed as an intermediate step toward the eventual calculation of economic performance measures. Accordingly, the assumptions used in the calculation of those user benefits have an influence on such measures of economic benefit as personal disposable income growth, employment growth, etc. Two conservative technical assumptions used in the calculation of travel time-related benefits are discussed below.

Free Flow vs. Congested Travel Times. Mobility benefits (i.e., time savings and consumer surplus) were based on free flow speed improvements vs. average daily speed improvements. The latter includes the effects of typical congestion, rendering the difference (i.e., benefit) between Build and No Build alternatives larger. Since mobility benefits are a major input to the economic analysis, larger mobility benefits would have translated into larger employment and income benefits. Yet, we chose the conservative assumption.

New Destination Choices in the Opening Year. Induced travel demand does not materialize over night and yet we treated it as if it does. In response to a major transportation improvement, changes in origin/destination choices that may result in longer average trip lengths occur over many years. However, in computing mobility benefits we elected to re-distribute trips to reflect this long-term increase in VMT not only in the forecast year, but also for the base year, thus affecting the opening year of the highway. Intervening years between opening year and analysis end year were interpolated based on this beginning point. A closer modeling of reality would have been to assume the No Build trip distribution in the opening year changing gradually over time to the Build distribution by the forecast year. This latter approach would have also resulted

[1] These numbers reflect the No Build assumption. The forecasted truck growth rate assuming I-69 Preferred Alternative 3C is built with the addition of induced travel demand turns out to be slightly less due to the short-cut the highway would provide. The annual compounded rate of truck tonnage growth in VMT would be 1.187%.

in higher mobility benefits for the build alternative leading to increased business activity and associated employment, income, etc.[2]

So What? A sensitivity analysis of the effects of these two assumptions were conducted in November 2002 for Alternative 3B. This sensitivity analysis revealed that the total undiscounted mobility benefit used for input to the economic analysis in 2025 would have been **$145.7 million** had we elected to use average daily speeds and the No Build trip table in the base year. Contrast this with the mobility benefits for the same alternative-same year using the DEIS assumptions: **$80.0 million**.

Committed Lane Additions on I-465

There are certain major projects to which INDOT presently has a firm commitment that were not treated as "committed" when the DEIS analysis began. Among these are the planned lane additions to I-465 between I-74 on the west and I-65 on the southeast side of Indianapolis. These major capacity enhancements are now under design and INDOT has firm plans to proceed with them.

Given the large effect that these projects will have on traffic flow at the northern terminus of the Evansville-to-Indianapolis section of I-69, we thought it might be instructive to learn what effect this added capacity would have on I-69's economic performance numbers had the widening of I-465 been assumed to be "committed" in the official analysis.

Table 9.2 contains a basic summary of the benefit cost analysis for Preferred Alternative 3C assuming these lane additions are in place by the time I-69 is open (which is likely to be the case). For ease of comparison, we are including the same data for "Scenario A" (reported in earlier chapters) in which the I-465 lane additions are not included.

Table 9.2 – 7% Discounted Value of Benefits and Costs for Preferred Alternative 3C: With and Without "Committed" I-465 Lane Additions (x $1,000)

	Status of I-465 Expansion	Total User Benefits	Total Costs Less Residual Value	Net Present Value	Benefit Cost Ratio
Alternative 3C	**With**	$2,034,873	$1,325,370	$709,503	1.535
	Without	$1,464,635	$1,325,370	$139,264	1.105

As the table indicates, the commitment of lane additions on I-465 would have a very large impact on the benefit cost results for Preferred Alternative 3C; in fact, the net present value would increase more than fivefold. This is largely due to the congestion relief that such a project will provide at the northern terminus of the I-69 project.

[2] For purposes of the benefit cost analyses reported in this document, the average daily travel times and the No Build trip table in the base year have been used. In the DEIS, which did not include formal benefit cost analysis, the more conservative assumptions were used as inputs for forecasting economic performance measures.

Summing Up

The effects on the economic performance measures of changing the economic inputs and I-465 assumptions discussed above are provided in Table 9.3.

Table 9.3 – Economic Performance Measures for I-69 Preferred Alternative 3C Under Three Sets of Assumptions[3]

Economic Performance Measure	Assumptions (1) Standard Assumptions in DEIS	(2) Average Daily Travel Times & No Build Base Yr Trip Table	(3) Same as (2) Plus Planned Lane Additions on I-465
Access to Labor Markets			
Increase in Accessibility to Population within 30-minute Drive (%)	4.3%	4.0%	7.3%
Access to Buyer / Supplier Markets			
Increase in Accessibility to Employment within 3-hour Drive (%)	3.8%	4.6%	6.0%
Change in Employment			
Total Change	4,610	5,270	7,460
Employment in High Paying Industries			
Change in Employment in 20 Highest-Paying Industries	1,420	1,710	2,270
Share of Change in Employment in 20 Highest-Paying Industries (%)	30.9%	32.4%	30.5%
Net Change in Real Disposable Income			
(2001 $)	173,144,000	200,064,000	283,435,000
Working-Age Population			
Change in Population for Ages 20 to 44	2,770	3,190	4,470

Clearly, had the less conservative assumptions represented in columns 2 and 3 of Table 9.3 been adopted in the *I-69 Evansville to Indianapolis Tier 1 Environmental Impact Statement* the economic performance measures would have shown significantly higher benefits. If these had been combined with higher truck forecasts as suggested by FHWA's *Freight Analysis Framework*, the economic performance measures would have been higher still.

[3] The data in column 3 of Table 9.3 are not perfectly compatible with the benefit cost numbers reported in Table 9.2 due to very recent changes in the benefit cost post-processor and a small change in the traffic assignment model run. They are, however, a reasonable order of magnitude.

Staff Qualifications

Vincent L. Bernardin, AICP

Principal/Vice President

Years of Corporate Experience	Since 1980
Total Years of Experience	29
Education	Master's of Urban Planning, Transportation, University of Illinois, Urbana, Illinois, 1975 Bachelor of Arts, Sociology/Economics (minor), University of Notre Dame, South Bend, Indiana, 1973
Certification	American Institute of Certified Planners, Charter Member
Professional Memberships	Institute of Transportation Engineers, Member (No. 17180) Transportation Research Board American Planning Association Indiana Planning Association

Expertise & Responsibilities

In February, 1980, Vince Bernardin and Keith Lochmueller opened their door for business as a consulting firm specializing in the field of transportation planning. Since that time, Mr. Bernardin has helped to build Bernardin, Lochmueller & Associates, Inc. (BLA) into one of the premier civil engineering and planning firms in the Midwest. During the same period, Mr. Bernardin developed a personal reputation as an outstanding expert in the field of travel demand forecasting and modeling. In addition to the following list of project-related work, Mr. Bernardin has written numerous computer programs to assist in such diverse planning areas as: model calibration statistics reporting, simultaneous link impedance adjustment, BPR Capacity Restraint Function parameter estimation, benefit/cost analysis, toll price elasticity-volume estimation, labor force linkage-cohort survival population forecasting, and a residential allocation model using the Lowry Method. Some of these programs have been soft-coded and upgraded into a planning utility package for INDOT and Indiana MPOs. He has also programmed several customized trip generation models based on statistical analysis of household travel survey data. Over the years, he has presented papers at national conferences and taught several short courses on various aspects of travel demand analysis and the Indiana Reference Modeling System (IRMS).

To this day Mr. Bernardin continues to exercise technical supervision and quality assurance for all transportation planning projects undertaken by BLA.

Project Experience

Important projects credited to Mr. Bernardin's leadership include:

I-69 Evansville to Indianapolis Tier 1 EIS, Indiana Department of Transportation, 1999-Present

Principal-in-Charge

Project Experience continued

Knoxville, Tennessee Regional Travel Demand Model Development and Calibration, Knoxville Metropolitan Planning Organization, 2002-2003

Project Manager

Ohio DOT On-Call MPO Travel Demand Modeling Contract, 2003-Present

Principal-in-Charge

Lexington, Kentucky Travel Demand Model Upgrade and Calibration, Kentucky Transportation Cabinet, 2002-2003

Project Manager

Indiana Statewide Specialized Planning Services Contract, Indiana Department of Transportation, 2002-Present

Project Manager

Little Rock Travel Demand Model and Emissions Analysis, Little Rock, Arkansas, MetroPlan, Alliance Transportation Group, 2003

Subconsultant Project Manager

Macatawa (Holland) Michigan, TransCAD Model Development, Macatawa Area Coordinating Council, 2002-2003

Principal-in-Charge

Indiana Statewide Travel Demand Model Update, Indiana Department of Transportation, Current update

Principal-in-Charge

Major Corridor Investment Benefit Analysis System, Indiana Department of Transportation, 1998

Subconsultant Project Manger

Indiana Statewide Transportation Planning Assessment Study, Indiana Department of Transportation, 1998

Project Manager

Transportation Model Assessment Study, Anchorage Metropolitan Area Transportation Study, 1997

Supervising Principal

Indiana Reference Modeling System, Indiana Department of Transportation, 1995

Author and Principal Developer

Project Experience continued

U.S. 31 Kokomo/Howard County Major Investment Study, Indiana Department of Transportation, 1995

Project Manager

U.S. 31 Hamilton County Major Investment Study, Indiana Department of Transportation, 1995

Project Manager

Calibration of TranPlan Travel Demand Models for The Benton Harbor - St. Joseph and Niles Urbanized Areas, Michigan Department of Transportation, 1994

Project Manager

Fort Wayne Area Network Conversion from PLANPAC/UTPS to MINUTP and Development of Modal Split Parameter Estimation Technique, Northeastern Indiana Regional Coordinating Council, 1992

Project Manager

Greater South Bend Area Long Range Transportation Plan Update and Model Development, Michiana Area Council of Governments, 1992

Project Manager

Greater Terre Haute Long Rang Transportation Plan and Model Development, West Central Indiana Economic Development Commission, 1990

Project Manager

Environmental Impact Statement and Corridor Location Study for the Relocation of US 231 in Lafayette, Indiana, Indiana Department of Transportation, 1990

Modeling/Forecasting Specialist

Traffic Impact Analysis of Subaru-Isuzu Automotive's Industrial Development, Tippecanoe County Commissioners, 1990

Project Manager

Environmental Assessment for the Extension of Interstate 265, Clark County, Indiana Department of Transportation, 1988

Modeling/Forecasting Specialist

Evansville Area Model Conversion from PLANPAC to MINUTP, Trip Generation Upgrade, Model Calibration and Forecasts, Evansville Urban Transportation Study, 1988

Project Manager

Project Experience continued

Interstate 265, Ohio River Toll Bridge Feasibility Study (1987) Greater Louisville Area, Indiana Department of Transportation

Project Manager

Previous Professional Experience

Prior to co-founding BLA, Mr. Bernardin spent four years as Executive Director of the Evansville Redevelopment Commission and one year as the Planner-in-Charge of the Evansville Urban Transportation Study (EUTS). While at EUTS, Mr. Bernardin programmed Evansville's first trip generation, modal split and auto occupancy models.

Updated 12/01/03

David Ripple, Ph.D., PE, AICP

Senior Associate, Chief of Transportation and Land Use Planning

Years of Corporate Experience
Since April 1997

Total Years of Experience
32

Education
Doctorate, Urban and Transportation Engineering, Purdue University, West Lafayette, Indiana, 1974

Master of Science, Civil Engineering, Purdue University, West Lafayette, Indiana, 1970

Bachelor of Science, Civil Engineering, Rose-Hulman Institute of Technology, Terre Haute, Indiana, 1969

Continuing Education
"Thinking Beyond the Pavement Design Workshop"

Context-Sensitive Design, University of Kentucky, 14 PDH, October, 2001

Professional Registration
Registered Professional Engineer in the states of:

Kentucky	No. 11409	1979
Indiana	No. 19600260	1996

Professional Memberships
American Planning Association, Past Kentucky Chapter President

American Institute of Certified Planners

Institute of Transportation Engineers

Expertise and Responsibilities
Dr. Ripple is a BLA Senior Associate, and the Chief of Transportation Planning and Land Use Studies. His responsibilities include metropolitan transportation plans, major transportation investment and corridor studies, transit and traffic impact studies, comprehensive land use plans, and growth management controls. Dr. Ripple has three decades of transportation and land use planning experience. He has managed the development of numerous regional and metropolitan transportation plans and corridor studies that have used travel demand models to assess options within and between modes. These studies have examined a wide range of transportation planning issues, including travel forecasting, alternative transportation modes, net-benefit/cost analyses, air quality conformity, alternative land use patterns, community and environmental considerations, and public consensus-building. Over the years, he served as Senior Planner for the first multi-modal Indianapolis Regional Transportation Plan, the Director of Advance Planning for the Louisville and Jefferson County (KY) Planning Commission for 13 years (including Acting Executive Director) creating the first policies-type comprehensive plan in the mid-west, and chairman of the Louisville (KY) MPO Technical Committee for over five years. Dr. Ripple also developed the first alternative modes plan in the Midwest incorporated into the development approval process, participated in the development of the Los Angeles Metro Rail and reconfiguration of bus systems in Miami-Dade County, Broward County (FL) and Detroit, created the feasibility study for the currently operating Meridan (MS) multi-modal transportation center, and prepared numerous comprehensive plans for Midwest communities. Having participated in BLA's ground-breaking Indiana Statewide

Expertise and Responsibilities continued

Transportation Planning Process Assessment Study, Dr. Ripple also produced the Chandler (IN) and Howard County (IN) comprehensive plans; the Final Report for the US 31 Major Investment Study for Marshall-St. Joseph counties (IN); directed origin-destination studies; and managed several traffic impact studies for business parks, the Evansville Riverfront and the Universities of Evansville and Southern Indiana.

Project Experience

Some of the projects Dr. Ripple has been responsible for include:

Delaware-Muncie, Indiana Western Growth Arterial Study, Delaware Muncie Metropolitan Plan Commission, 2003

Project Manager

I-66/Bowling Green, Kentucky Outer Beltline Study, Kentucky Transportation Cabinet, 2003

Transportation Manager

Kankakee, Illinois Corridor Study, Kankakee County Regional Planning Commission, 2003

Transportation Manager

US 31 St. Joseph/Marshall County, Indiana EIS, Indiana Department of Transportation, 2003

Transportation Manager

I-69 Henderson, Kentucky to Evansville, Indiana EIS, Kentucky Transportation Cabinet, Indiana Department of Transportation, 2002

Subconsultant Transportation Manager

SR 101, Indiana Corridor Study, Indiana Department of Transportation, 2002

Subconsultant Project Manager

Bloomington-Normal, Illinois East Side Bypass Study, McLean County Regional Planning Commission, 2002

Transportation Manager

Statewide Open-ended Corridor Planning Studies

Kentucky Transportation Cabinet, I-64, US 27/I-75 Connector, the Eminence Bypass, US 41A, Webster County, KY 55, Nelson/Spencer County, US 150/I-75 Connector and US 641 Calloway County), 1998-2002

Project Manager

Project Experience continued

Delaware-Muncie, Indiana Connections Study, Delaware Muncie Metropolitan Plan Commission, 2001

Subconsultant Project Manager

Evansville Indiana Long-Range Transportation Plan, Evansville Urban Transportation Study, 2000

Project Manager

Terre Haute, Indiana 2025 Long-Range Transportation Plan, West Central Indiana Economic Development District, 2000

Project Manager

Bloomington, Indiana 2025 Long-Range Transportation Plan and Thoroughfare Plan, Bloomington Area Transportation Study, 2000 & 2001

Project Manager

Previous Professional Experience

Prior to joining BLA, Dr. Ripple was a Vice President with The Corradino Group (headquartered in Louisville, Kentucky) for twelve years from 1985 to 1997. As head of Urban Planning and Development for the Midwest, he was responsible for all land use and traffic impact studies, and he was project manager for transportation and transit studies.

Dr. Ripple's Managing Transportation Projects include:

Transportation plans for Jackson (Mississippi), Boone County (Kentucky), Downtown Louisville, and Georgetown - Scott County (Kentucky).

Traffic/air quality impact and circulation studies for the Downtown Louisville Waterfront Project, the JH Properties' Stony Brook site in Louisville, the Louisville Commonwealth Convention Center Expansion, the Lexington (Kentucky) Belmont/Pemberton Farms Industrial Park, the University of Lexington's Coldstream Research Campus, Lexington South Park Farm, downtown Louisville Corporate Plaza Garage, Jewish Hospital Parking Strategy and Garage Feasibility Studies for downtown Louisville, and the Indianapolis Hillsdale Retail Center.

Riverboat gaming traffic impact studies for proposed Indiana casino developments in Jeffersonville, Vevay, Harrison County, and Dearborn County.

Multi-Modal transportation centers in Louisville (KY) and Meridian and Jackson (MS).

Dr. Ripple served as Senior Transportation Planner on such projects as:

Transportation plans for Indianapolis (Indiana) and Columbus (Ohio).

Transit plans and centers for Broward County (Florida), Greater Detroit, Akron (Ohio),

Previous Professional Experience continued

Greensboro (North Carolina), Springfield (Illinois), Springfield (Missouri), Charlottesville (Virginia), Knoxville (Tennessee), OKI (Cincinnati, Ohio), Topeka (Kansas), Louisville (Kentucky), Los Angeles Metro Rail and Miami Metro Bus.

Dr. Ripple's Managing Land Use Projects include:

Comprehensive planning and land use control efforts in Indiana for Dearborn County, Bloomington, Petersburg, Clarksville, Sellersburg, Orleans, and Scottsburg/Scott County; in Michigan for Kalamazoo, Pontiac and Portage; and in Kentucky for Louisville/Jefferson County (e.g., alternative mode site design standards), Frankfort and Lexington.

Public approval for numerous mixed-use development plans in Louisville/Jefferson County such as the 212-acre Hurstbourne Green Office Park, 100-lot upscale residential Kensington Place, 30-acre Kensington Business Park, 7-acre Cross commercial development, 27-acre JH Properties' Stony Brook commercial development and the 23-acre City Place of the Paragon Group.

Urban renewal plans for downtown, neighborhood and airport locations in Louisville and Jefferson County, Kentucky.

Prior to The Corradino Group, Dr. Ripple was the Director of the Advance Planning Division of the Louisville and Jefferson County (Kentucky) Planning Commission for 13 years from 1973 to 1985, including Acting Executive Director in 1982. As Division Director, he was responsible for the preparation of the agency's work program and budget, program coordination with other agencies (e.g., chairman and member of the metropolitan transportation technical committee) and direction of all studies (including the first "policies type" comprehensive plan in Kentucky, two dozen neighborhood plans, and downtown development guide). As Acting Executive Director, Dr. Ripple was responsible for the management of 40 people who administered land use controls and prepared policy guides for development decisions.

Updated 9/02/03

Kyeil Kim, Ph.D.

Senior Transportation Modeler

Years of Corporate Experience

Since May, 1998

Total Years of Experience

12

Education

Doctorate in Civil/Transportation Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1998

Master's Degree, Civil Engineering, Transportation Engineering, The University of New South Wales, Sydney, Australia, 1995

Bachelor's Degree, Urban Planning Hanyang University, Seoul, Korea, 1991

Professional Memberships

American Planning Association

Institute of Transportation Engineers

Korea Transportation Research Society

Korean Transportation Association in America

Continuing Education

"Kentucky Traffic Model Users Group MUG & Stakeholders,"

Kentucky Transportation Cabinet, July 22, 2003

"Advanced Urban Travel Demand Forecasting"
NHI Course No. 152050, FHWA, Charleston, West Virginia, March, 2002

"Improvements on Kentucky Statewide Traffic Model Training"
Frankfort, Kentucky, March, 2000

"Geographic Information System Developer's Kit Language Training"
Boston, Massachusetts, August, 1999.

"Intensified Computer Language Training Course"
Joongang Computer Academy, Seoul, November 1988 through August 1989

Expertise & Responsibilities

Dr. Kim is BLA's senior transportation modeler. His modeling expertise has been an invaluable resource on projects such as the I-69 Evansville to Indianapolis Tier I EIS. His I-69 related contribution have included: (1) the development of the current version of NET_BC, which has been used for computing user benefits; (2) development and application of post-processors for computing proximity measures for the Tier 1 alternatives; and (3) calibration and application of the new bi-state TransCAD model used for testing alternatives for the Evansville-Henderson segment of I-69. He has or is currently calibrating several metropolitan area TransCAD models. Current or recently completed projects include: models for Knoxville TN, Lexington KY, and Holland MI. He has in-depth experience working with the Indiana Statewide Travel Demand Model, most recently for an economic analysis of INDOT's Long-Range Transportation Plan. He is the associate project manager for BLA's on-call specialized planning services contract with INDOT. Dr. Kim has written several scholarly papers and has research interests in highway management systems and multi-factorial transportation decision-making processes. Dr. Kim works out of our Indianapolis office.

Kyeil Kim, Ph.D.

Senior Transportation Modeler

Project Experience

Ohio DOT On-Call MPO Travel Demand Modeling Contract, 2003-Present

Project Manger

I-69 Evansville to Indianapolis, Indiana Tier 1 EIS, Indiana Department of Transportation, 1999-Present

Dr. Kim is working on the User Benefit-Cost Analysis, development of Transportation Performance Evaluation Measures, and the I-69 Travel Demand Model development for this important Indiana project.

Macatawa (Holland) Michigan, TransCAD Model Development, Macatawa Area Coordinating Council, 2002-2003

Dr. Kim was the Project Manager for the TransCAD Model Development for this Macatawa Area Coordinating Council project.

Knoxville, Tennessee Regional TransCAD Travel Demand Model Development and Calibration, Knoxville Metropolitan Planning Organization, 2002-Current

Dr. Kim is the Associate Project Manager for this project.

Indiana Statewide Specialized Planning Services Contract, Indiana Department of Transportation, 2002-Current

Dr. Kim is the Associate Project Manager on this project for INDOT. He is responsible for the Economic Analysis of the statewide Plan, TransCAD Statewide Travel Demand Model upgrade/calibration, and several related analytical/programming tasks.

Lexington, Kentucky Travel Demand Model Upgrade and Calibration, Kentucky Transportation Cabinet, 2002-2003

Dr. Kim was the Associate Project Manager responsible for the MINUTP to TransCAD Travel Demand Model Conversion and Upgrade/Calibration.

Delaware-Muncie County, Indiana Western Growth and Arterial Study, Delaware-Muncie Metro Planning Commission, Indiana, 2002

Dr. Kim was responsible for the TransCAD Travel Demand Model Development/Calibration and Alternatives Testing for this project.

Evansville, IN - Henderson, KY, 2025 Transportation Plan Update Phase III, Evansville Urban Transportation Study, 2002

Dr. Kim was responsible for the TransCAD Travel Demand Model Development/Calibration for the expanded 5-county Regional Model, and the User Benefit-Cost Analysis for this project spanning two states.

Evansville, IN - Henderson, KY, 2025 Transportation Plan Update Phase II: Air Quality Conformity, Urban Transportation Study, 2000

Dr. Kim worked on the air quality conformity during the second phase of the 2025 Transportation Plan Update.

Project Experience continued

Update of the Interstate Interchange Evaluation System Study, Indiana Department of Transportation, 2000

Dr. Kim was responsible for the Interchange Needs Prioritization for this project.

Terre Haute/Vigo County 2025 Long Range Transportation Plan and Model Development, West Central Indiana Economic Development District, 1999

Dr. Kim was responsible for the Phased Capital Improvement Program and Budget Allocation, Socioeconomic and External Travel Data Forecasts, Development of Recommended Transportation Plan, and the TRANPLAN Travel Demand Model Development/Calibration for this project.

Kokomo-Howard County Transportation Plan Update, Kokomo and Howard Counties, Indiana, 1999

Dr. Kim was responsible for the Socioeconomic and External Travel Data Forecasts and the Year 2025 Traffic Demand Forecasts using TRANPLAN Model for this project.

US 27 - I-75 Connector Study; I-66 Study; US 41A Webster County Scoping Study; KY 55 Nelson; Spencer County Scoping Study; Kentucky Transportation Cabinet, 1999

Dr. Kim was responsible for the MINUTP Year 2025 Traffic Demand Forecasts and Highway User Benefits Analysis for this project.

I-64 Strategic Corridor Planning Study, Indiana Department of Transportation, 1999

Dr. Kim was responsible for the Existing Capacity/Level of Service (LOS) Analysis and Year 2025 MINUTP Traffic Demand Forecasts for this project.

Indiana Statewide Transportation Planning Assessment Study, Indiana Department of Transportation, 1998

Dr. Kim was responsible for the development of a Traffic Forecasting Tool, development of Expansion/Preservation Projects Sufficiency Rating System and development of Prototype Planning Products for this project.

Bloomington, Indiana 2025 Long-Range Transportation Plan and Thoroughfare Plan Update, Bloomington Area Transportation Study, 1998

Dr. Kim was responsible for development of I.U. Travel Demand Model Components, External Travel Demand Forecasts, and TRANPLAN Model Calibration and Validation for this project.

Papers & Presentations

Kim, Kyeil, Bernardin, Vince and Smith, Steve, "Traffic Forecasting Tool: A GIS-Based Forecasting Application for the Indiana Department of Transportation," Accepted for presentation at the Eighth TRB Conference on the Application of Transportation Planning Methods, Corpus Christi, Texas, April, 2000.

Kim, Kyeil and Bernardin, Vincent L., *"An Application of an Analytic Hierarchy Process at the Indiana Department of Transportation for Ranking Major Highway Capital Investments,"* Seventh TRB Conference on the Application of Transportation Planning Methods, Boston, March, 1999.

Papers & Presentations continued

Drew, Donald R., Kim, Kyeil, and Siess E.J., *"Modeling the AHS Guideway-Freeway Interface."* Presented at the 31st International Symposium Automotive Technology and Automation Conference, Düsseldorf, Germany, June 1998.

Drew, Donald R., de la Garza, Jesus M., Kim, Kyeil and Sin, H.G., *"Simulation of Highway Life-Cycle Planning for Sustainable Development."* Presented at the Summer Computer Simulation Conference, Reno, Nevada, July 1998.

Drew, Donald R. and Kim, Kyeil, *"Modeling Highway Management Systems for Sustainable Development."* Presented at the 1998 Modeling and Simulation Conference, the International Association of Science and Technology for Development, Pittsburgh, Pennsylvania, May 1998.

Drew, Donald R., Sohn, D. and Kim, Kyeil, *"AHS/MAGLEV: A Supply-Side Approach to Sustainable Development."* Presented at the 30th International Symposium Automotive Technology and Automation Conference, Florence, Italy, June 1997.

Kim, Kyeil, *"An Investigation into Overflow Queue Lengths and Degree of Saturation at an Oversaturated Signalized Intersection."* Master's Thesis, The University of New South Wales, Sydney, Australia, February 1995.

Previous Professional Experience

Before joining the staff of BLA, Dr. Kim was a Graduate Teaching/Research Assistant, at Virginia Tech for two years. At the University of New South Wales, Sydney, Australia, he was a Research Assistant from March 1994 to February 1995. Dr. Kim was a Transportation Planner/Modeler for Yooshin Engineering Corporation, Seoul, Korea, from June 1990 to January 1993.

Doctoral Research

A Transportation Planning Model for State Highway Management: A Decision Support System Methodology for Sustainable Development.

In his dissertation, Dr. Kim developed a highway management system model for the Virginia Department of Transportation. The model employs a decision support system methodology for assessing socioeconomic benefits arising from an improved management program of the Virginia highway systems. The major objectives of the model include:

- Forecasting future travel demand on all levels of highways in Virginia,
- Development of a highway aging model,
- Development of a highway management model, which includes a Pavement Management System and a Bridge Management System,
- Development of a transportation financing model, which addresses revenue generation and budget allocation processes,
- Development of a regional economy model, which estimates the gross state product and employment,
- Investigation of a cause-and-effect feedback relationship among travel demand, levels of highway management, budget allocations, and regional economy, and
- Recommendations as to efficient budget allocations for highway systems to maintain a sufficient level of highway condition.

Master's Research

An Investigation into Overflow Queue Lengths and the Degree of Saturation at an Oversaturated Signalized Intersection.

Previous Professional Experience continued

In his thesis, Dr. Kim suggested the method of calculating optimum signal timings for an oversaturated intersection in Sydney, Australia, during the morning peak period. The major objectives of his research included:

- Estimation of average overflow queue lengths by capturing the traffic conditions of the intersection using video cameras,
- Determination of degrees of saturation during the three-hour morning peak period,
- Estimation of total delay and average delay per vehicle,
- Investigation of the relationship between overflow queue lengths and the degree of saturation,
- Investigation of the relationship between the average delay and the degree of saturation, and
- Calculation of the signal timings which minimize the total delay and number of stops.

Updated 12/01/03

Michael Grovak

Chief of Transit Planning and Economics

Years of Corporate Experience

Since April 1996

Total Years of Experience

20

Education

Bachelor of Science, Civil Engineering, Transportation Systems, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1974.

This degree was earned in only three years of study.

Continuing Education

"NEPA & the Indiana Transportation Decision Making Process,"

24 Hours, Conducted by INDOT and FHWA on July 28-30, 2003

Expertise & Responsibilities

Mr. Grovak provides expertise in all phases of transit planning and operations. Areas of special expertise include cost and revenue forecasting; route and schedule design; rider surveys; traffic checking; service delivery guidelines; operational improvement studies; and operational feasibility studies. Since joining BLA, Mr. Grovak has served as project manager for several major corridor and transportation studies. These studies have benefitted from his outstanding expertise in transportation economics. Some major projects include:

Project Experience

I-69 Indianapolis to Evansville Tier 1 EIS, Indiana Department of Transportation, 1999-Present

Mr. Grovak serves as the Project Manager for this Environmental Impact Statement which has a 26-county study area covering one-quarter of the State of Indiana. BLA is the prime consultant to the Indiana Department of Transportation for this study. This study is one of the largest NEPA studies ever conducted for a highway project. The DEIS for this project was issued in July, 2002. Mr. Grovak's responsibilities as Project Manager include:

- Overseeing the work of BLA staff and 11 subconsultants;
- Writing and/or editing all project reports;
- Analysis of transportation and regional economic benefits in a 26-county study area;
- Overseeing project web page; and
- Overseeing media inquiries and contacts.

US 31 Plymouth to South Bend, Indiana EIS, Indiana Department of Transportation, 2003

For this study, BLA was a subcontractor to Wilbur Smith Associates. Mr. Grovak was the project manager for BLA's portion of the study. He provided capital and operating cost estimates for 14 alternatives, determined user benefits for each alternative, determined the user cost/benefit ratio for each alternative, and performed a macroeconomic analysis of the effects of several of the alternatives. For this macroeconomic analysis, Mr. Grovak used a Regional Economic Model, Inc. (REMI) model to measure the changes in personal income to Indiana residents which would result from implementing the alternatives studied.

Project Experience continued

Mr. Grovak presented this study's findings in a paper presented at the January, 2000 annual meeting of the Transportation Research Board.

Metropolitan Evansville, Indiana Transit System, Comprehensive Needs Analysis, 1999

In 1998, Bernardin, Lochmueller, and Associates, Inc. (BLA) was hired to conduct a thorough assessment of unmet transit needs in the city of Evansville, to determine the cost of meeting those needs, and to identify funding sources for any increased operating costs. BLA completed a complete origin-destination survey of all Metropolitan Evansville Transit System (METS) weekday riders, a survey of area employers, and a survey of community-based organizations. The employer and community-based surveys used cluster-based sampling to target employers and organizations which provide access to those most likely to use transit service. BLA conducted these surveys entirely "in house" with its own staff. The final recommendations included new service to meet unmet transit needs, cost, ridership, and revenue projections for the recommended service, and recommended sources of funding. Recommendations include an innovative one-to-many concept, "METS Connection," serving outlying transit terminals which are also major retail centers.

KY 69 Corridor Study, Kentucky Transportation Cabinet, 1997

In this study, Mr. Grovak combined an AASHTO "Red Book" analysis of user benefits with a macroeconomic analysis of the economic development impact of an upgraded highway facility. Using BLA's "NET_BC" model post-processor, travel time, vehicle operating, and safety benefits were estimated for an upgrade of approximately 40 miles of KY 69 in north central Kentucky. These user benefits became inputs to the Regional Economic Model, Inc. (REMI) model to estimate the economic development impact of this improvement. Economic impacts were estimated for a multi-county study area, as well as for all of Kentucky. Mr. Grovak presented this study's findings in a paper presented at the January, 1998 annual meeting of the Transportation Research Board.

Previous Professional Experience

Prior to joining BLA, Mr. Grovak held the following positions:

- Senior Director, System Data and Traffic, New York City Transit Authority
- Superintendent, Service Analysis and Research, Chicago Transit Authority
- Senior Service Planner, Denver Regional Transportation District

Mr. Grovak was the project director for the following projects:

Restoration of Traffic Checking, New York City Transit Authority (NYCTA), 1985-1988

For at least 15 years prior to Mr. Grovak's being hired by NYCTA, the Authority had NO systematic program of bus traffic checking, and limited rail traffic checking. Surveys of bus ridership and operating performance were done ad hoc, usually in response to complaints. Rail traffic checking consisted of a single individual recording the passenger loads on trains up to 11 cars long. Mr. Grovak reinstituted the practice of routine traffic checking on both modes using part-time surveyors. As a result of this effort, the NYCTA bus fleet was reduced by over 200 vehicles, with an annual operating savings of over $10,000,000.

Previous Professional Experience continued

Service Planning Guidelines, New York City Transit Authority, 1986-1988

To systematically use the results of traffic checking to modify operating schedules, Mr. Grovak wrote or edited six policy documents which were adopted by the NYCTA Board as Authority policy. These specified where, when and how often bus and subway service should be provided as functions of ridership and population demographics. These were the first official policies adopted by the NYCTA Board and remain its official guidelines for provision of transit service.

Archer Avenue Corridor Survey, New York City Transit Authority (NYCTA), 1987-1989

In December of 1988, NYCTA opened its first major subway extension in decades, the Archer Avenue extension. It directly affected service on three subway routes, as well as many bus routes. In order to plan the bus and subway changes in conjunction with this extension, Mr. Grovak conducted and analyzed two major surveys of bus and subway riders. Fifteen percent of the approximately 145,000 weekday riders affected were surveyed. The results of this survey were a key determinant of the final bus and subway route structure for this extension.

Section 15 Rail Surveys, New York City Transit Authority, 1987-1988

Mr. Grovak's staff designed the first surveys which determined within statistical parameters the passenger miles traveled on the New York City Transit Authority subway system. Fare paying passengers were known from turnstile registrations. What was unknown, was the average trip length and the ratio between fare paying passengers and other riders (such as pass users and transfer riders). The critical issue was the (unknown) variance of average trip length. By assuming that the variance was arbitrarily large (through constrained by the physical routings of the subway network), his staff designed a sampling plan which met the precision requirements for Section 15 reporting.

Updated 12/01/03

Bruce Pake, AICP

Senior Transportation Planner

Years of Corporate Experience

Since December, 1997

Total Years of Experience

24

Education

Master of Science, Transportation Engineering, University of Virginia, Charlottesville, Virginia, 1986

Master's of Public Administration, University of Virginia,Charlottesville, Virginia, 1985

Bachelor of Arts, Grinnell College, Grinnell, Iowa, 1978

Professional Memberships

Institute of Transportation Engineers

American Planning Association

Professional Registration

American Institute of Certified Planners, 1989

Expertise & Responsibilities

Mr. Pake is a Senior Transportation Planner and is responsible for project management and technical analysis in numerous transportation planning and travel demand forecasting projects. Mr. Pake has managed a wide variety of transportation planning projects with focused experience in travel demand modeling. Mr. Pake has developed and applied demand models for metropolitan areas, business districts, airports, highway corridor studies and transit corridor studies. In addition to providing travel demand forecasts, he has conducted capacity analyses for various types of existing and proposed highway facilities. During his tenure at East-West Gateway, Mr. Pake updated the Greater St. Louis area's travel demand model and conducted a major multimodal alternatives analysis in St. Clair County, Illinois. In 1998, Mr. Pake developed one of the first applications of the revised Kentucky Statewide Traffic Model for BLA's I-64 Strategic corridor Planning Study. He has applied the Paducah Urban Area Traffic Simulation Model for demand forecasts for five I-24 bypass alternatives in Paducah, Kentucky. He recently developed/calibrated an expanded MINUTP model for the Bowling Green Kentucky area, which was used for testing alternative locations for the extension of I-66. In early 2002, Bruce did a major update of the Bloomington-Normal IL TRANSPLAN model which was subsequently applied to test the feasibility of an proposed major bypass.

Project Experience

I-66/Bowling Green Outer Beltline, Corridor Location and Environmental Overview, Bowling Green, Kentucky, Kentucky Transportation Cabinet, 2002

Mr. Pake is the Senior Transportation Modeler for this project.

East Side Corridor Feasibility Study, Bloomington-Normal, Illinois, McLean County Regional Planning Commission, 2002

Mr. Pake was the Senior Transportation Modeler for this project.

Project Experience continued

Bypass Corridor Location Study, Paducah, Kentucky, Kentucky Transportation Cabinet, 1998
Mr. Pake was the Senior Transportation Modeler for this project.

US 27/I-75 Connector Study, Jessamine and Madison Counties, Kentucky, Kentucky Transportation Cabinet, 1997

Mr. Pake was the Senior Transportation Modeler for this project.

I-64 Kentucky Statewide Strategic Corridor Plan, Kentucky Transportation Cabinet, 1998

Mr. Pake was the Senior Transportation Modeler for this project.

Previous Professional Experience

Manager of Transportation Planning

Garmen Associates, Montville, New Jersey

Projects while with Garmen Associates included:

New York City Air Quality Impact Analysis for Transportation Control Measures, 1997

Mr. Pake developed off-model quantitative assessments for VMT impacts of over 100 transportation control measures (TCM's), including added express bus service, transit park-and-ride lots, and bikeways. These assessments were largely based on adaptations of Congestion Mitigation for Air Quality (CMAQ) techniques.

Route 1 South Brunswick Travel Pattern Analysis, South Brunswick, New Jersey, New Jersey Department of Transportation, 1996

Mr. Pake served as project manager and travel demand modeler for project forecasts, select link analysis, and capacity analysis in a highway corridor study. This analysis required application of the North Jersey Regional Transportation Model, with subarea validation at the level of interchange turning movements and individual development parcels.

I-78/Route 22 Corridor Study, Somerset and Union Counties, New Jersey, New Jersey Department of Transportation, 1995

Mr. Pake directed travel pattern analyses for selected highway facilities. This study determined local/regional composition of traffic, using quick-response data collection and North Jersey Regional Transportation Model select link analyses.

Manager of Systems Planning

East-West Gateway Coordinating Council, St. Louis, Missouri

Projects while with the East-West Gateway Coordinating Council included:

Previous Professional Experience

St. Clair County Alternatives Analysis, St. Clair County, Illinois, 1992-1994

Mr. Pake developed an update of the St. Louis MPO transit demand modeling procedures, including innovations in estimating congested bus speeds, multi-path transit assignment, and downtown parking cost estimation.

Long-Range Plan Travel Demand Model Update, St. Louis, Missouri, 1991-1993

Mr. Pake managed and performed a broad range of travel modeling tasks, in order to support St. Louis area long-range planning. In this capacity, Mr. Pake introduced "demand-responsive" trip distribution and other innovations to the St. Louis MPO model. Mr. Pake documented the St. Louis MPO modeling procedures in the 1994 ITE publication, "Travel Demand Forecasting Process Used by Ten Large Metropolitan Planning Organizations."

Senior Transportation Planner

Vollmer Associates, Boston, Massachusetts & Collinsville, Illinois. Mr. Pake was transferred to the Collinsville Office of Vollmer Associates for a 2 year period from May, 1988 to March, 1990.

Projects while with Vollmer Associates included:

Signalization Study, Illinois Route 157 & County Highway 35, Collinsville Illinois, 1989

Signalization Study, West Main & North Sixth Streets, Belleville, Illinois, 1989

Augusta Third Bridge Study, Augusta, Maine, Maine Department of Transportation, 1990

Mr. Pake updated and automated a 25-year old urban travel model, in order to support traffic forecasts for a bridge design and location study.

Updated 04-28-03

Kent L. Ahrenholtz, PE

Associate

Years of Corporate Experience

Since March, 2002

Total Years of Experience

17

Education

Master of Science, Engineering Management, University of Kansas, Lawrence, Kansas, 1996

Bachelor of Science, Civil Engineering, Iowa State, University, Ames, Iowa, 1986

Continuing Education

"NEPA & the Indiana Transportation Decision Making Process,"

24 Hours, Conducted by INDOT and FHWA on July 28-30, 2003

Professional Registration

Registered Professional Engineer in the states of:

Missouri	E-024792	1991	Kentucky	22952	2003
Iowa	E-13907	1995	Ohio	E-67795	2003
Nebraska	E-8932	1995	Tennessee	108568	2003
Texas	E-87104	1999	Indiana	PE10302158	2003
Illinois	062-056526	2003	Arkansas	11581	2003

Professional Memberships

Institute of Transportation Engineers

Missouri Society of Professional Engineers, Western Chapter PEPP (Past President)

Kansas City Engineers Club (Past President)

Papers/Presentations

"Trade Corridor Planning: Lessons Learned"

8th Transportation Research Board Conference on the Application of Transportation Planning Methods 2001 and 1999 at the Midwest Transportation Planning Conference sponsored by the FHWA, the Iowa DOT and Des Moines Area MPO.

"ISTEA Transportation Enhancement for Communities in Iowa"

1998 Midwest Transportation Planning Conference. Sponsored by the FHWA, Nebraska Department of Roads and the Omaha MPO.

"Urban Toll Roads: Are They Really an Option?"

American Society of Civil Engineers, 1995, San Diego, California and published in the proceedings of papers for conference (Transportation Congress "Civil Engineers - Key to the World's Infrastructure, Volume I, pp. 967-977).

Expertise & Responsibilities

Mr. Ahrenholtz brings to BLA, his expertise in transportation planning solutions, namely of being able to take charge of developing innovative, well-supported solutions to complex and controversial transportation projects. Along with his sensitivity to community needs, an ability to communicate difficult problems and concepts in ways that people understand, a talent to proactively manage projects and a knack for developing business and retaining clients has proven to be a major asset for BLA and its clients. Throughout the past ten years he has

Expertise & Responsibilities continued

managed projects in Iowa, Nebraska, Missouri, Kansas, Arkansas, Texas and Colorado of varying size and scope including location/feasibility studies, environmental studies, preliminary and final designs, public/agency involvement and construction monitoring/partnering.

Project Experience

A sample of projects since joining BLA include:

I-66 Corridor and Bowling Green Outer Beltline Planning Studies, Kentucky Transportation Cabinet, 2003

Mr. Ahrenholtz was the Deputy Project Manager responsible for the management and coordination of the planning studies and environmental overviews for this project. As part of this work, Mr. Ahrenholtz analyzed and directed preparation of the horizontal and vertical alignments, preliminary cost estimates, reports and exhibits for a study of two separate projects in the same general vicinity of southern Kentucky. Each project has its own purpose and need, but portions of the I-66 Corridor could potentially serve as a part of the Outer Beltline. Therefore, a rigorous study of the compatibility of the two projects is underway.

Indiana Statewide Specialized Planning Services Contract, Indiana Department of Transportation, 2002-2003

Mr. Ahrenholtz assisted with the management and coordination of a specialized planning services contract for INDOT. Under this contract, BLA and its team are updating and expanding the statewide travel demand model for the state of Indiana.

Previous Professional Experience

Before joining the staff of BLA, Mr. Ahrenholtz held the position of Planning Department Manager at HNTB in San Antonio, Texas. Other positions held in his 15 year tenure with the firm included: Transportation Engineer, Project Manager, and Senior Project Manager, Kansas City, Kansas; Project Engineer, Overland Park, Kansas; and Transportation Department Manager, Denver, Colorado. He was Project Manager for numerous multi-state corridor studies and corridor planning projects.

Mr. Ahrenholtz's ***Multi-State Corridor Studies*** included:

National I-10 Freight Corridor Study, Los Angeles, California to Jacksonville, Florida, Texas Department of Transportation as lead for the eight-state National I-10 Freight Corridor Steering Committee.

Mr. Ahrenholtz was Project Manager responsible for management, coordination and planning for HNTB on the Freight Corridor Study of this 2,500 mile, multi-state corridor project.

I-69 Corridor/ISTEA Corridor 18 Special Issues and Special Environmental Studies, Port Huron, Michigan to Lower Rio Grande Valley, Texas, Arkansas Highway and Transportation Department as lead for eight-state I-69 Corridor Steering Committee

Mr. Ahrenholtz was responsible for management, coordination and planning the special environmental study of this 1,600 mile, multi-state corridor project.

Ports to Plains Corridor Feasibility Study, Texas/Mexico Border to Denver, Colorado, Texas Department of Transportation as lead for the four-state Ports to Plains Corridor Study Steering Committee

Previous Professional Experience, continued

As Project Manager he was responsible for HNTB's efforts for the feasibility study of this proposed international trade corridor from the Texas/Mexico border via I-27 to Denver.

I-35 Trade Corridor Study, Laredo, Texas to Duluth, Minnesota, Texas Department of Transportation as lead for the six-state I-35 Trade Corridor Steering Committee.

As Project Engineer, Mr. Ahrenholtz was involved with peer review on an intermodal study to determine future improvements along I-35.

Mr. Ahrenholtz's ***Corridor Planning Projects*** included:

IH 30 Corridor Improvement Project, Hunt, Hopkins and Franklin Counties, Texas, Texas Department of Transportation.

As Deputy Project Manager, he was responsible for management, coordination, planning and design efforts for this 12-mile $500 million interstate expansion.

IH 410 Southwest Corridor Route Studies/Schematic Design, Culebra Road to IH 35, San Antonio, Texas, Texas Department of Transportation.

Mr. Ahrenholtz was Deputy Project Manager for management, coordination, planning and design efforts for this 12-mile $500 million project which included interstate expansion in southwest San Antonio. The team performed route studies, environmental assessments, schematic design and right-of-way maps for expansion of IH 410 from six lanes to eight lanes, as well as reconfiguration of three freeway-to-freeway interchanges.

Ft. Leonard Wood Intermodal Study, St. Roberts, Missouri, Missouri Department of Transportation

Project Manager responsible for two-phase study of improvement to highways and other transportation modes.

Brady South Location Study and Preliminary Design, Nebraska Department of Roads

As Project Manager, Mr. Ahrenholtz was responsible for management and coordination of all disciplines and subconsultants for the location study and preliminary design phases of this 2.0 mile, $7.0 million railroad grade separation and Platte River Bridge construction from Interstate 80 to Brady, Nebraska.

U.S. 63 Corridor Study, Rolla, Missouri, Missouri Department of Transportation (Willow Springs District)

Mr. Ahrenholtz was the Project Manager responsible for management and coordination of all disciplines and subconsultants for the corridor feasibility study phase, which included location and environmental studies of this $60 million improvement of U.S. 63 and other state routes around Rolla, Missouri. This study transformed from a standard bypass study into a unique hybrid corridor/area study through input received from the public. The solution the team developed for this project is a unique combination of improvement projects on several state highways in the Rolla area which best meet the purpose and need of the project.

Lake of the Ozarks Community Bridge, Camden County, Missouri, Missouri Department of Transportation (Jefferson City District)

Mr. Ahrenholtz was the Project Manager responsible for management and coordination of a

Previous Professional Experience, continued

multi-discipline team for the feasibility study phase, the final design and construction plans phase, and the construction phase services and operations planning support phase of this innovative public/private 5.5 mile, $40.085 million toll bridge across the Lake of the Ozarks in central Missouri and its corresponding approach roadways. Each phase of the project was completed under a fast-track schedule. This project was the first public/private project in Missouri to utilize new litigation passed for this purpose.

Route 5 Corridor Study, Lake of the Ozarks, Missouri, Missouri Department of Transportation

Mr. Ahrenholtz was the Project Manager responsible for location and environmental study phases of this 40-mile, $220 million expressway-type improvement of Route 5 through the Lake of the Ozarks region.

Ozark Mountain Highroad, Branson, Missouri, Missouri Department of Transportation

As Project Engineer and CADD Coordinating Engineer, Mr. Ahrenholtz was responsible for highway design and evaluation, plan preparation, and computer-aided design and drafting for the award-winning location and environmental study and preliminary design phases of this 17.5 mile, $150 million western loop around Branson.

South Lawrence Trafficway, Lawrence, Kansas, Douglas County, Kansas (Public Works Department)

Mr. Ahrenholtz was the Project Engineer responsible for coordination of all disciplines in the preparation of a Supplemental Environmental Impact Statement and associated studies of the southern leg of this 14.5 mile, $55 million expressway and bypass to the west and south of Lawrence, Kansas. He was also responsible for highway design, plan preparation, and CADD for preliminary design phases of the expressway and bypass of Lawrence, Kansas.

Other ***Transportation Studies*** included:

San Antonio Regional Corridor Plan, San Antonio, Texas, San Antonio-Bexar County Metropolitan Planning Organization

Project Manager for update of San Antonio's major thoroughfare plan, incorporation of access management guidelines into the plan, and analysis of several high growth corridors.

Lewisville Lake Toll Bridge Feasibility Study, Dallas Texas, North Texas Tollway Authority

Project Manager responsible for HNTB's efforts for the feasibility study of constructing a toll bridge crossing over Lewisville Lake and running from IH 35E in Lake S Dallas, Texas to the Dallas North Tollway near Frisco that included an engineering analysis and cost estimates of the overall feasibility study.

Iowa Transportation Enhancement Assistance, State of Iowa, Iowa Department of Transportation

Previous Professional Experience, continued

Deputy Project Manager responsible for management and coordination of HNTB disciplines in assisting the Iowa Department of Transportation with the administration of Iowa's Transportation Enhancement Program which includes construction or reconstruction of bikeways and trails, archaeological and historic/architectural preservation and scenic and natural resources.

Updated 12/01/03

Jonathan Avner

Transportation Planner II

Years of Corporate Experience	Since February, 2003
Total Years of Experience	6 years
Education	Master's Candidate, Urban Geography, McMaster University, Hamilton, Ontario, Canada, 2003 Bachelor of Arts, Urban Geography, McMaster University, Hamilton, Ontario, Canada, 1997

Continuing Education

"Advanced Urban Travel Demand Forecasting,"
National Highway Institute, May 2001

"Synchro and SimTraffic Training Course,"
University of Nebraska-Lincoln, September 2000

"Air Quality,"
Texas Transportation Institute, February 2000

"Air Quality,"
National Highway Institute, January 2000

"Demographic Data Collection,"
Texas Transportation Institute, December 1998

Papers and Presentations

Outputs from Travel Demand Models for Operational Analysis, Eighth Transportation Research Board Conference on the Application of Transportation Planning Methods (April, 2001)

Expertise & Responsibilities

Mr. Avner is the newest addition to BLA's transportation planning staff. With five years of experience, Mr. Avner comes to us from the State of Texas, where he participated in the development and application of San Antonio's TransCAD model. He also contributed to the Texas-North American Freight Flow Study and toll feasibility studies for the Central Texas Turnpike Authority. One of his unique specialties is the interface between travel demand model forecasts and operational simulation software for operational analysis. He is the author of a paper on this subject delivered at the Transportation Research Board's 8th Conference on the Application of Transportation Planning Methods.

Project Experience

Ohio DOT On-Call MPO Travel Demand Modeling Contract, 2003-Present

Mr. Avner's responsibilities include detailed statistical analysis of all household and trip data records for recently completed household travel surveys in nine MPO's across the State of Ohio.

Macatawa (Holland) Michigan, TransCAD Model Development, Macatawa Area Coordinating Council, 2002-2003

Mr. Avner was responsible for the development of the model update and validation. He also provided on-site training for the client on how to use the new model.

Project Experience continued

Little Rock Travel Demand Model and Emissions Analysis, Little Rock, Arkansas, MetroPlan, Alliance Transportation Group, 2003

Mr. Avner was responsible for the development of the trip generation program using a recently completed household survey.

TRANPLAN Model Conversion, City of Bloomington, Indiana, 2003

Mr. Avner was responsible for the conversion and development of the TRANPLAN model to TransCAD. Mr. Avner also provided on-site training on the new model for the client.

I-66 Corridor and Bowling Green Outer Beltline Planning Studies, Kentucky Transportation Cabinet, 2003

Mr. Avner worked on the development of forecast plots for traffic report and volume capacity analysis of alternative.

I-69 Evansville to Indianapolis, Indiana Tier 1 EIS, Indiana Department of Transportation, 2003

Mr. Avner assisted in sensitivity testing of alternative capacity scenarios on I-465 in Indianapolis near the northern terminus of the I-69 project.

US 31 Plymouth to South Bend, Indiana EIS, Indiana Department of Transportation, 2003

Mr. Avner is responsible for the travel model validation and alternative testing.

Previous Professional Experience

Prior to joining BLA in February 2003, Mr. Avner worked for about three years with Alliance-Texas Engineering Company in increasingly responsible positions, including project management for travel demand modeling projects. Transportation planning and modeling projects on which he worked included:

East Corridor Multimodal Alternatives Plan, San Antonio, Texas

Mr. Avner developed refined travel demand model for testing of forecast alternatives.

Brooks City: Base Area Infrastructure Needs Assessment, San Antonio, Texas

Mr. Avner developed refined travel demand model for the testing of forecast alternatives.

Texas-North American Freight Flow Model, Texas Department of Transportation

Using the REEBIE Transearch Database, Mr. Avner developed trip tables and assigned them to the North American TransCAD network.

DeZavala Road Corridor Study, San Antonio, Texas

Mr. Avner developed a refined travel demand model for testing of operational improvements to the corridor.

State Highway 130 Level III Toll and Revenue Study, Texas Department of Transportation, Central Texas Turnpike Authority

Mr. Avner developed traffic forecasts to be used as part of the Toll and Revenue Study for the proposed toll road.

Previous Professional Experience continued

State Highway 130 Operational Analysis, Texas Department of Transportation, Central Texas Turnpike Authority

Mr. Avner was responsible for developing traffic forecasts for input into operational simulation software to assist in the design of proposed interchanges on toll road.

US 281 Corridor Study, McAllen, Texas, Texas Department of Transportation

Mr. Avner used the MPO Regional Travel Demand Model to develop traffic forecasts on three proposed alignments for a new highway.

I-35 San Antonio Corridor Study, Texas Department of Transportation

Mr. Avner developed a refined travel demand model to develop traffic forecasts on five-lane arrangement concepts including HOV and Express Facilities. Traffic forecasts were put into operation simulation software.

State Highway 130 Level II Toll Feasibility Study, TxDOT, Central Texas Turnpike Authority

Mr. Avner assisted in developing an eight-county regional travel demand model to develop traffic forecasts on eight different proposed alignments for a future toll road in Central Texas.

State Highway 130 External O-D Survey, TxDOT, Central Texas Turnpike Authority

Mr. Avner was responsible for the geocoding of Origin-Destination data from the External Station Survey. Conducted as part of the State Highway 130 Level II Toll Feasibility Study.

Circle T Suburban Activity Center

Using a refined travel demand model developed traffic forecasts based on several land use and roadway plans for large development.

From May 1998 to early 2000, Mr. Avner worked as a transportation planning analyst for the Texas Department of Transportation in the Traffic Analysis Section of the Transportation Planning and Programming Division. Projects that he worked on while at Texas Department of Transportation included:

- Corpus Christi Travel Demand Model
- Midland-Odessa Travel Demand Model
- State Highway 286/State Highway 358 Corridor Study Analysis, Corpus Christi, Texas

Updated 12/01/03

Vincent Bernardin, Jr., BA

Transportation Planner

Years of Corporate Experience
Since 2002

Total Years of Experience
2

Education
Bachelor of Arts, Honors Philosophy/Minor in Physics, University of Notre Dame, South Bend, Indiana, 2001

Magna Cum Laude

Continuing Education
"Kentucky Traffic Users Group MUG & Stakeholders

July 22, 2003, Kentucky Transportation Cabinet

"Applying Models in CUBE"

November 11-22, 2002, Ohio Department of Transportation/Citilabs

"Using REMI Policy Insight for Economic Forecasting, Planning, and Policy Analysis,"

August 20, 2002, Regional Economic Models, Inc.

"Kentucky Model Users Group Speed Estimation Seminar,"

August 14, 2002, Kentucky Transportation Cabinet

"Travel Demand Modeling/Advanced TransCAD Workshop,"

June 10-14, 2002, INDOT/Caliper Corp., at Purdue University

Expertise and Responsibilities
Vince Bernardin, Jr., is a Transportation Planner assisting in travel model development and a variety of forecasting and modeling applications. Vince has been instrumental in refining the Indiana Statewide Travel Model, and has used the model to rerun I-69 Evansville-Indianapolis Tier 1 EIS alternative corridor refinements (with associated net benefit/cost, proximity and accessibility analyses). He has added refinements to the Evansville (IN) Regional Travel Model to allow either truck pre-load or simultaneous multimodel assignments and to examine subarea development buildout traffic impacts. Vince was also responsible for developing the trip generation modules for the Lexington-Fayette County/Jessamine County (KY) and the Knoxville (TN) regional travel models from household travel surveys conducted in Knoxville and Evansville. He also developed the external trip matrices for the Lexington regional travel model, and assisted in preparing the purpose and need statement for the US 31 South Bend-St. Joseph County/Marshall County (IN) EIS as well as the US 31 travel model.

Project Experience
I-69 Evansville-Indianapolis Tier I EIS, Indiana Department of Transportation, 2002-2003

Mr. Bernardin's responsibilities included running the Indiana Statewide Travel Demand Model and its various post-processors, including Post_Alt and NET_BC, both for the final calculation of the travel-model-based performance measures for the various alternatives as well as for several sensitivity analyses.

I-69 Henderson, Kentucky to Evansville, Indiana EIS, Kentucky Transportation Cabinet, Indiana Department of Transportation, 2003

Mr. Bernardin developed a GISDK program for TransCAD to execute an alternative

Project Experience continued

assignment method (a simultaneous multimodal assignment) for the Evansville Area Travel Model, assisted in the model runs, ran the NetBC post-processor for the model to obtain user benefits and costs, ran the REMI macroeconomic regional model and was responsible for the associated economic impact analysis.

TRANPLAN Model Conversion, City of Bloomington, Indiana, 2003

Mr. Bernardin reproduced the trip generation program written in QBASIC using GISDK so that it could be seamlessly incorporated into TransCAD model runs. He also converted the external-external trip tables from TRANPLAN format into a TransCAD compatible format.

Evansville Area Year 2025 Long Range Transportation Plan Update and New Travel Model Development, Evansville Urban Transportation Study, 2001

In addition to developing a GISDK program for TransCAD to execute a multimodal assignment to simultaneously assign truck and automobile trips as a part of the I-69 Henderson, KY, to Evansville, IN, EIS, Mr. Bernardin also wrote an alternative trip generation algorithm for the study of build-out scenarios in subareas of the model, designed a new graphical user interface for the model which incorporated the model's post-processors, made a number of network additions and corrections and re-validated the model's calibration. Mr. Bernardin also developed an air quality post-processor for the travel model in GISDK which allows the user to make a complete set of thirty Mobile6 Mobile Source Emission Factor Model runs with the push of a button and generate emissions both for the non-attainment area of the model as well as reporting emissions on a link-by-link basis.

Lexington, Kentucky Travel Demand Model Upgrade and Calibration, Kentucky Transportation Cabinet, 2002-2003

Mr. Bernardin was responsible for the trip generation module of the model. He also developed the base and forecast year external-external trip tables, and produced forecast year socioeconomic control totals for the model area. He further was responsible for the development of two post-processors: a new Post_Alt program to produce traffic statistics which was calibrated to the observed average peak period speeds on arterial corridors and the development of an air quality post-processor for the travel model which allows the user to make a complete set of thirty Mobile6 Mobile Source Emission Factor Model runs with the push of a button and generate emissions both for the non-attainment area of the model as well as reporting emissions on a link-by-link basis.

Knoxville, Tennessee Regional Travel Demand Model Development and Calibration, Knoxville Metropolitan Planning Organization, 2002-2003

As Transportation Planner, Mr. Bernardin's responsibilities have thus far included statistical analysis of the Knoxville Area Household Travel Behavior Study and production of a GISDK program for the trip generation and Household stratification components of the new model.

Indiana Statewide Specialized Planning Services Contract, Indiana Department of Transportation, 2002-2003

Mr. Bernardin oversaw the development of a zone geography and associated socioeconomic database for a zone system with over 4,000 traffic analysis zones and

Project Experience continued

coordinated and participated in the addition of collector-level network and new centroid connectors throughout the state. He also developed automated tools to incorporate traffic signals into the network and calculate the green time ratios and arrival types for each approach.

Economic Analysis of Indiana Long-Range Plan, 2002-2003

As Transportation Planner and Analyst, Mr. Bernardin was responsible for adapting and running the Indiana Statewide Travel Demand Model for the analysis of the statewide plan as well as running BLA's NET_BC software to post-process the model to obtain user benefits and costs of programmed projects. He also assisted Dr. Kim in the refinement of the NET_BC program to incorporate the vehicle operating costs of idling at traffic signals and new cost-speed curves estimating vehicle operating costs associated with constant speed vehicle operation.

I-66 Corridor and Bowling Green Outer Beltline Planning Studies, Kentucky Transportation Cabinet, 2003

As Transportation Planner, Mr. Bernardin was responsible for using Forecast Pro software and the Labor Force Linkage Cohort Survival Methodology to develop socioeconomic forecasts for the Delaware-Muncie Travel Demand Model and also provided technical documentation of the socio-economic forecasting process.

Delaware-Muncie County, Indiana Western Growth and Arterial Study, Delaware-Muncie Metro Planning Commission, Indiana, 2002

For this project, Mr. Bernardin was responsible for using Forecast Pro software and the Labor Force Linkage Cohort Survival Methodology to produce socioeconomic forecasts for the Delaware-Muncie Travel Demand Model and the associated technical documentation. He developed the model's Post_Alt post-processor for the calculation of traffic statistics and assisted Dr. Kim in running alternative traffic assignments and BLA's NET_BC software to compute user benefits and costs associated with the various alternatives.

US 31 Plymouth to South Bend, Indiana EIS, Indiana Department of Transportation, 2003

As Transportation Planner and Analyst, Mr. Bernardin was responsible for producing regional socioeconomic forecasts and the development of post-processors to generate performance measures and air quality impacts for the alternatives. He also assisted Mr. Avner in the alteration and re-validation of the Indiana Statewide Travel Demand Model to incorporate new network and zonal detail in and around the study area.

Previous Professional Experience

Prior to joining BLA, Mr. Bernardin was a student at the University of Notre Dame, Notre Dame, Indiana and the Holy Cross Novitiate in Colorado Springs, CO.

Updated 9/02/03

Daniel Townsend, EIT

Transportation Engineer

Years of Corporate Experience

Since January, 1998

Total Years of Experience

7

Education

Bachelor of Science, Civil Engineering, Purdue University, West Lafayette, Indiana, 1997

Professional Registration

Registered Engineer-In-Training in the following states:

Indiana	#39700611	1997

Professional Memberships

American Society Civil Engineers (ASCE)

National Society of Professional Engineers (NSPE)

Order of Engineers

Expertise and Responsibilities

Mr. Townsend has developed a strong expertise in GIS development, applications and mapping. He contributed extensively to the 26-county environmental EIS for I-69 Tier 1. Mr. Townsend created all of the base maps for the EIS. Mr. Townsend also contributed to the cumulative effects analysis and applied the rural interchange development model for estimating indirect impacts. Moreover, he has developed the TransCAD model networks and zonal databases for several metropolitan area models and has contributed to metropolitan area demographic and employment forecasts under the supervision of Dr. Ripple.

Project Experience

I-69 Evansville to Indianapolis Tier 1 EIS, Indiana Department of Transportation, 1999-Present

Mr. Townsend's responsibilities included collection and manipulation of planning and environmental data for the development of a GIS database covering the 26-county study area. He used ArcView GIS in the GIS development and to create base maps. He also used ArcView GIS to create preliminary route concept maps. Mr. Townsend created all of the corridor base maps for this project. He contributed to the cumulative effects analysis and applied the rural interchange development model for estimating indirect impacts.

Lexington, KY Multi County TransCAD Travel Demand Model, Kentucky Transportation Cabinet, 2002

- Attached Highway Inventory System (HIS) data to the TransCAD network
- Completed quality control checking on converted network
- Assisted with geocoding business locations for incorporation in TAZ database
- Utilized Yr 2000 Census data in the development of the TAZ database
- Assisted with verification of traffic count data

Project Experience continued

Indiana Statewide Travel Demand Model Update, INDOT, 2002-2003

Mr. Townsends responsibilities includes expansion of current statewide network by adding collectors and updating Year 2000 TAZ Database.

Knoxville, TN Regional Travel Demand Model, Knoxville Metro Planning Organization, 2002 - Present

Mr. Townsend is currently advising the MPO Staff on the merging/tagging of GIS based link attributes and network conflation. Mr. Townsend's additional responsibilities include:

- Adding network to the expanded regional modeled area
- Developing new Travel Analysis Zones (TAZ) for the expanded study area
- Developing base year TAZ data
- Developing attribute data for the added network

The work will be completed by using ArcView and Maptitude programs. Data sources include Yr 2000 census and Tennessee Roadway Information Management System (TRIMS)

Statewide Indiana GIS, Indiana Department of Transportation, 2002-Present

BLA, with assistance from the Indiana Geological Survey, is the lead consultant in the development of a statewide environmental GIS with 170 layers. Mr. Townsend is one of BLA's team members bringing his ArcView and MAPTITUDE skills and database knowledge to the project.

Interstate Interchange Evaluation Study, Indiana Department of Transportation, 1999-2001

Mr. Townsend was responsible for using MAPTITUDE GIS to complete GIS drawings of each interstate interchange in the State of Indiana overlaid on aerial photography.

Evansville Area Year 2025 Long Range Transportation Plan Update and New Travel Model Development, Phase I: Transportation Plan Update, Evansville Urban Transportation Study, 2001

Mr. Townsend was responsible for collecting historical socioeconomic data for population, employment, labor force, income, households and vehicle registrations. Used Forecast Pro and Labor Force Linkage-Cohort Survival Method to produce 2025 county control total forecasts for the three county study area. Used ArcView GIS to produce an area map for inclusion in the Leadership Survey.

Evansville Area Year 2025 Long Range Transportation Plan Update and New Travel Model Development, Phase II: Air Quality Conformity, Evansville Urban Transportation Study, 2001

Mr. Townsend was responsible for researching costs of the projects to be included in the Transportation Plan Update as part of the 2025 Plan Benefit Cost Analysis.

Project Experience continued

Evansville Area Year 2025 Long Range Transportation Plan Update and New Travel Model Development, Phase III: Regional TransCAD Model Development, Evansville Urban Transportation Study, 2001

Mr. Townsend oversaw all TransCAD network development for this project and was responsible for developing the zonal socioeconomic database and forecasting 2025 control totals for the two additional counties included in the EUTS regional model.

Kokomo-Howard County Comprehensive Plan, Kokomo-Howard County Plan Commission, 1998-2001

Mr. Townsend used ArcView GIS and MAPTITUDE GIS to produce nineteen figures included in the community profile report. The figures included a location map, points of interest, historical properties, waterways and floodplains, wetlands, existing land use and existing zoning.

Bloomington Transportation Plan Update, City of Bloomington, Indiana, 1998-2000

Mr. Townsend was responsible for collecting socioeconomic data from various sources, including the Internet, REIS and the 1990 Census. He used the Forecast Pro program to forecast county control totals for employment, labor force, and other socioeconomic factors to the year 2025. Mr. Townsend also used the Labor Force Linkage-Cohort Survival Methodology to forecast county population in the year 2025. He participated in the Delphi Process to allocate future growth between the Traffic Analysis Zones, and used ArcView GIS to produce an area map as part of the Indiana University student trip survey. Mr. Townsend was also responsible for estimating construction, right-of-way and total costs for projects in each alternative being considered. He estimated residual value and annual operating and maintenance costs. Mr. Townsend used MAPTITUDE GIS for Windows to create base maps and maps of each alternative.

KY 55, Nelson/Spencer Counties, Kentucky Transportation Cabinet, 1999-2000

Mr. Townsend was responsible for using ArcView GIS to produce report graphics. Created maps showing the alternates, project area overview, existing traffic volumes, accident rates, committed projects and future daily volumes for alternates.

US 31 Toll Road Feasibility Study, Indianapolis to South Bend, Indiana, Indiana Department of Transportation, 1999

Mr. Townsend was responsible for costing segment alignments for each alternative being considered. Cost items included roadway, bridges, interchanges, rest areas, toll facilities, maintenance of traffic, right-of-way and engineering. He took part in the process of deciding treatment of crossroads along proposed alignments. Mr. Townseand updated costs for segments from the previous MIS reports and estimated costs for remaining segments of each alternative. He was also responsible for calculating residual values and annual operating and maintenance costs of each alternative. He used MAPTITUDE GIS to produce alternative maps. Each alternative map showed segment alignments, locations of grade separations, interchange locations and existing road network overlaid on a USGS Land Use/Land Cover layer.

Project Experience continued

I-64 Statewide Strategic Corridor Plan, Bowling Green, Kentucky, Kentucky Transportation Cabinet, 1999

Mr. Townsend used MAPTITUDE GIS and ArcView GIS to produce base maps and environmental maps along the I-64 corridor. Other maps produced included committed projects, ramp and mainline traffic volumes, ramp and mainline level of service and potential operational and functional improvements. Maps depicted both existing and future conditions.

Terre Haute/Vigo County Long Range Transportation Plan, West Central Indiana Economic Development District, 1999

Mr. Townsend was responsible for forecasting county socioeconomic control totals to the year 2025. He utilized the Forecast Pro program and the Labor Force Linkage-Cohort Survival Methodology to produce the forecasts. He used Maptitude GIS to produce graphics for the Plan report. Graphics included locations of proposed improvement projects, on-going projects, major traffic problems in year 2025, and the future transportation needs plan.

Kokomo Long Range Transportation Plan, Kokomo-Howard County Plan Commission, 1999

Mr. Townsend was responsible for using Forecast Pro and the Labor Force Linkage-Cohort Survival Methodology to forecast year 2025 county socioeconomic control totals. He also provided technical documentation of the socioeconomic forecasting process.

Kentucky Major Highway Corridors Limited Scoping Studies, Kentucky Transportation Cabinet, 1998

Mr. Townsend's responsibilities included calculations of present and future conditions, and using ArcView GIS. Mr. Townsend has used ArcView GIS to create base maps and environmental maps for the study corridors.

US 27/I-75 Connector Study, Kentucky Transportation Cabinet, 1998

Mr. Townsend utilized data from the Kentucky Natural Resources Geographic Information System website to produce base maps, environmental maps and alternative maps. He was responsible for calculating residual values and annual operating and maintenance costs for each alternative.

Updated 9/02/03